University of Belgrade
Faculty of Organizational Sciences

XV INTERNATIONAL SYMPOSIUM

2016 symorg

RESHAPING THE FUTURE
THROUGH SUSTAINABLE
BUSINESS DEVELOPMENT
AND ENTREPRENEURSHIP

June 10 - 13, 2016
Congress center
Ratko Mitrović
ZLATIBOR, SERBIA

UNIVERSITY OF BELGRADE
FACULTY OF ORGANIZATIONAL SCIENCES

SYMORG 2016

Zlatibor, June 10-13, 2016

XV INTERNATIONAL SYMPOSIUM

RESHAPING THE FUTURE THROUGH SUSTAINABLE BUSINESS DEVELOPMENT AND ENTEPROURESHIP

SYMPOSIUM PROCEEDINGS

Editors:
Ondrej Jaško, PhD
Sanja Marinković, PhD

Zlatibor, 2016

Publisher
University of Belgrade, Faculty of Organizational Sciences
Jove Ilića 154, Belgrade, Serbia
www.fon.bg.ac.rs

Dean of Faculty of Organizational Sciences
Milija Suknović, PhD

Designed by
Milan Okanović, Lena Đorđević

Printing
NEWPRESS d.o.o.
Lukijana Mušickog 131, Smederevo, SERBIA

Year
2016

Conference Organizer
University of Belgrade, Faculty of Organizational Sciences, Serbia

FOREWORD

The Faculty of Organizational Sciences, University of Belgrade, traditionally organizes SymOrg to promote the theory and practice of management and management-related disciplines. We are very pleased to present the Proceedings of the XV International Symposium of Organizational Sciences – SymOrg 2016. As in the previous years, the Symposium has given an opportunity for the participants to share and exchange both academic and practical knowledge and experience in a pleasant and creative atmosphere.

The topic of SymOrg 2016 was "Reshaping the Future through Sustainable Business Development and Entrepreneurship". We are pleased that this topic attracted researchers from different institutions, both from Serbia and abroad. The Business forum and the panel discussion which was a part of the StartUp Day competition gave added value to the Symposium and helped narrow the gap between science and practice.

Sustainable business development and entrepreneurship are relevant topics of interest for researchers in different fields. In line with their competences, they conduct analyses and research, and make new discoveries. New technologies and new business models are changing the present business environment with significant impact on the future. Numerous opportunities for business development imply incremental improvement or breakthrough changes of products, services and processes.

Innovation and entrepreneurship are seen as key drivers for the creation of more sustainable economies and societies. The management of today should facilitate business development to be more sustainable economically, socially and environmentally. This poses many questions and challenges for researchers and practitioners. We hope that some answers given by the authors at SymOrg 2016 will help in (re)shaping the future for the wellbeing of all generations.

The authors have contributed with around 200 papers. Around 500 authors and co-authors, scholars and practitioners are represented with their contributions in the Proceedings. The broad themes of the Symposium have allowed for exploration of different aspects of these areas:

- Business Analytics and Optimization
- Communication Management
- Corporate restructuring
- Data Science and Business Intelligence
- Electronic Business
- Entrepreneurship
- Environmental Management
- Financial Management
- Human Resource Management
- ICT and Management
- International Management
- Knowledge Management
- Marketing Management
- Operations Management
- Project Management
- Public Administration Management
- Quality Management
- Software Engineering
- Strategic Management
- Sustainable Business Development
- Technology and Innovation Management

Proceedings contain full papers accepted for presentation at the Symposium. It also includes extended abstracts of invited keynote speakers, to whom we express appreciation for taking part in this year's SymOrg.

We want to thank the contributors and the reviewers who made this issue possible. The Faculty of Organizational Sciences expresses gratitude to institutions, associations and individuals who have given support and contributed to the realization of the Symposium: the Ministry of Education, Science and Technological Development, sponsors, participants and volunteers.

Belgrade, May 25, 2016

Editors:
Ondrej Jaško, PhD
Sanja Marinković, PhD

PROGRAM COMMITTEE SymOrg 2016

UNIVERSITY OF BELGRADE, FACULTY OF ORGANIZATIONAL SCIENCES

Ondrej Jaško, Ph.D., chair

Boris Delibašić., vice-chair

Vesna Bogojević Arsić, Ph.D., member

Vesna Damnjanović, Ph.D., member

Mirjana Drakulić, Ph.D., member

Jovan Filipović, Ph.D., member

Vinka Filipović, Ph.D., member

Bojan Ilić, Ph.D., member

Milica Kostić Stanković, Ph.D., member

Dragana Kragulj, Ph.D., member

Saša Lazarević, Ph.D., member

Maja Levi Jakšić, Ph.D., member

Aleksandar Marković, Ph.D., member

Milan Martić, Ph.D., member

Dobrivoje Mihailović, Ph.D., member

Vesna Milićević, Ph.D., member

Gordana Milosavljević, Ph.D., member

Jasmina Omerbegović Bijelović, Ph.D., member

Dejan Petrović, Ph.D., member

Nataša Petrović, Ph.D., member

Dragoslav Slović, member

Dušan Starčević, Ph.D., member

Biljana Stošić, Ph.D., member

Milija Suknović, Ph.D., member

Mirko Vujošević, Ph.D., member

Dragan Vukmirovic, PhD., member

Nevenka Žarkić-Joksimović Ph.D., member

PROGRAM COMMITTEE SymOrg 2016

INTERNATIONAL PROGRAM COMMITTEE

Nina Begićević, Ph.D., Faculty of Organization and Informatics, University of Zagreb, Croatia

Peter Bielik, PhD. rector, Slovak University of Agriculture, Nitra, Slovakia

Heri Bezić, Ph.D., Faculty of Economics, University of Rijeka, Croatia

Adriana Budeanu, Ph.D., Copenhagen Business School, Denmark

Stanka Setnikar Cankar, Ph.D., Faculty of Administration, University of Ljubljana, Slovenia

Thomas Cleff, Ph.D., Business School, Pforzheim University, Germany

Marko Ferjan, Ph.D., Faculty of Organizational Sciences, University of Maribor, Slovenia

Stanislav Karapetrovic, Ph.D., Faculty Of Engineering, University of Alberta

Zohar Laslo, Ph.D., Shamoon College of Engineering, Israel

Robert Leskovar, Faculty of Organizational Sciences, University of Maribor, Slovenia

Ivan Luković, Ph.D., Faculty of Technical Sciences, University Of Novi Sad, Serbia

Pece Mitrevski, Ph.D., Faculty of Information and Communication Technologies, University "St. Kliment Ohridski" – Bitola, Macedonia

Boris Najman, Ph.D., Université Paris-Est Créteil, France

Ganesh Nathan, Ph.D., SBS Swiss Business School, Switzerland

Marina Papanastassiou, Ph.D., Business School, Middlesex University, United Kingdom

Gheorghe Savoiu, Ph.D., Faculty of Economic Sciences, University of Pitesti, Romania

Arnis Sauka, Ph.D., Associate Professor, Stockholm School of Economics in Riga, Sweden

Joaquim Ramos Silva, Ph.D., Associate Professor at ISEG/UTL, University of Lisbon, Portugal

Alberto Silva, Ph.D., Associate Professor at Instituto Superior Técnico, University of Lisbon, Portugal

Janez Stare, Ph.D., Faculty of Administration, University of Ljubljana, SloveniaVjeran Strahonja, Ph.D., Faculty of Organization and Informatics, University of Zagreb, Croatia

ORGANIZING COMMITTEE SymOrg 2016

UNIVERSITY OF BELGRADE, FACULTY OF ORGANIZATIONAL SCIENCES

ORGANIZING COMMITTEE

Sanja Marinković, Ph.D., chair
Gordana Savić, Ph.D., member
Ognjen Pantelić, Ph.D., member
Miloš Milosavljević, Ph.D., member
Dušan Barać, Ph.D., member
Marina Dobrota, Ph.D., member
Barbara Simeunović, Ph.D., member
Branka Novčić, Ph.D., member
Tatjana Ratković, Ph.D., member

TECHNICAL COMMITTEE

Veljko Dmitrović, Ph.D., member
Dragan Bjelica, member
Biljana Cvetić, member
Lena Đorđević, member
Bisera Andrić Gušavac, member
Svetlana Jovanović, member
Zoran Rakićević, member
Nemanja Milanović, member
Ana Horvat, member
Ema Nešković, member
Minja Marinović, member
Milica Jovanović, member
Marija Novaković, member
Goran Militarov, member
Uroš Šošević, member
Andrej Novović, administrative officer, contact person

CONTENT

INVITED TALKS

(RE)SHAPING OR ESCAPING THE FUTURE? ATRANSDISCIPLINARY PERSPECTIVE ON SUSTAINABLE DEVELOPMENT AND THE ROLE OF BUSINESS I
Adriana Budeanu, Copenhagen Business School, Denmark

DESIGN THINKING APPROACH TO ETHICAL (RESPONSIBLE) TECHNOLOGICAL INNOVATION III
Nathan Ganesh, University of Applied Sciences and Arts Northwestern Switzerland, Switzerland

A NEW ENVIRONMENT FOR ENTREPRENEURSHIP AS A LEVER OF SUSTAINABLE BUSINESS DEVELOPMENT VI
Joaquim Ramos Silva, University of Lisbon, Portugal

RSLINGO4PRIVACY: AN INTEGRATED APPROACH TO IMPROVE THE SPECIFICATION AND ANALYSIS OF PRIVACY POLICIES VIII
Alberto Rodrigues Da Silva, University of Lisbon, Portugal

BUSINESS ANALYTICS AND OPTIMIZATION 1

MEASURING SOCIAL PREFERENCES USING EXPERIMENTAL GAMES: LITERATURE REVIEW 2
Kuzmanović Marija, Blažić Tijana

AHP GROUP DECISION MAKING: EXAMPLE OF SELECTING EVALUATORS FOR EVALUATION OF PERFORMANCE OF MILITARY MOTOR VEHICLES DRIVERS 10
Lukovac Vesko, Pamučar Dragan, Gigović Ljubomir

MULTICRITERIA DECISION MAKING - PRACTICAL EXAMPLE OF AHP BASED APPROACH FOR SUPPLIER SELECTION 18
Mihailovic Jovana

EFFICIENCY EVALUATION OF ABA LEAGUE TEAMS FOR THE SEASON 2012-13 THROUGH DMU CLUSTERING AND DEA 26
Mitrović Maja

APPLICATION OF GENETIC ALGORITHM IN AUTOMATED TRADING 34
Jovanović Pavle, Rakićević Aleksandar, Petrović Bratislav

ON A PARAMETRIC APPROACH TO IMPROVE THE SOLUTION TO A FUZZY BI-CRITERIA TRANSPORTATION PROBLEM 41
Stanojević Bogdana, Stanojević Milan

OPTIMAL ADJUSTMENTS OF ORDER QUANTITIES DUE TO PACKAGING AND TRUCK CONSTRAINTS 48
Đorđević Aleksa, Belić Ana, Makajic-Nikolic Dragana

OPTIMAL HETEROGENEOUS STAFF SCHEDULING IN CASE OF PLANNING A SPECIAL EVENT 54
Hadžiahmetović Maja, Marinović Minja

AGENT-BASED MODELS: A REVIEW OF APPLICATIONS 61
Zornic Nikola, Markovic Aleksandar

THE INFLUENCE OF EDUCATIONAL DEVELOPMENT INDICATORS ON GRADUATES' EMPLOYMENT RATES 68
Bjelaković Ana, Dobrota Marina

IMPACT OF LARGE EXPORTERS' OWNERSHIP STRUCTURE ON THE GROWTH OF EXPORT IN SERBIA 76
Jeremić Zoran

THE ALTERATION OF U21 RANKING METHODOLOGY: FROM EXPERT-DRIVEN TO DATA-DRIVEN WEIGHTING SCHEME 83
Maričić Milica, Bulajić Milica, Dobrota Marina

SELECTING AN APPROPRIATE METHOD FOR MISSING DATA IMPUTATION: A CASE OF COUNTRIES RANKING 91
Rakićević Jovana, Savić Gordana, Bulajić Milica

THE CONJOINT ANALYSIS OF PARENTS' PREFERENCES TOWARDS CHILDREN'S PHYSICAL ACTIVITIES 100
Šormaz Jelena, Kuzmanović Marija, Jeremić Veljko

COMMUNICATION MANAGEMENT 110

ONLINE COMMUNICATION OF CORPORATE SOCIAL RESPONSIBILITY 111
Malinović Sonja, Vlastelica Tamara, Cicvarić Kostić Slavica

MANAGING DIGITAL MARKETING COMMUNICATION IN ORGANIZATIONS IN SERBIA 119
Veselinović Tamara, Vlastelica Tamara, Lalić Danijela

SOCIAL MEDIA AND PUBLIC SECTOR - THE EXPERIENCE OF THE USE OF SOCIAL MEDIA IN STATE ORGANIZATIONS AND SERBIAN DEFENSE STRUCTURE 125
Đurić-Atanasievski Ksenija, Bobar Zoran

RESHAPING THE FUTURE OF COMMUNICATION BY RESHAPING CRM 133
Jugovic Tijana, Milosev Dejana, Vukmirovic Valentina

BRAND DESIGN IN FUNCTION OF SUSTAINABLE CUSTOMER COMMUNICATION DEVELOPMENT 139
Kostić-Stanković Milica, Vukmirović Valentina

EFFECTS OF BUNDLING NON-COMPLEMENTARY PRODUCTS – COMMUNICATION PERSPECTIVE 146
Aćimović Vera, Cicvarić Kostić Slavica, Vlastelica Tamara

CORPORATE RESTRUCTURING 152

DMS AS A PROACTIVE APPROACH IN RESPONSIBLE RESTRUCTURING 153
Stanojević Terzić Slobodanka

MODEL FOR RESTRUCTURING PUBLIC PROCUREMENT SYSTEM IN SERBIA 160
Todorović Ivan, Komazec Stefan, Jaško Ondrej

PUBLIC PROCUREMENT CENTRALIZATION – FUNCTIONS OF THE CENTRAL BODY FOR PUBLIC PROCUREMENTS 170
Komazec Stefan, Todorović Ivan, Jevtić Miloš

DATA SCIENCE AND BUSINESS INTELLIGENCE 179

DATA WAREHOUSE FOR GLOBAL AIR TRANSPORT DEVELOPMENT 180
Nenadović Ana
AUTOMATIC CREATION OF CLINICAL PATHWAYS – A CASE STUDY 188
Kirchner Kathrin, Marković Petar, Delias Pavlos
ASSOCIATION RULE MINING: MODERN BUSINESS APPROACH 195
Istrat Višnja, Matović Dajana, Palibrk Milko
PREDICTING RISK OF BUYING LOW QUALITY CAR WITH RAPID MINER 201
Mitic Nemanja, Jankovic Ana, Vukicevic Milan
PREDICTIVE MODELLING FOR CLAIMS PROCESSING – CASE STUDY OF BNP PARIBAS 207
Sreckovic Stefan, Suknovic Milija, Vukicevic Milan
LOGICAL CLASSIFICATION METHOD FOR BANKRUPTCY PREDICTION 213
Marković Dragana, Živančević Sanja, Poledica Ana
BUILDING A DATA-ENRICHED DEX-BASED DECISION SUPPORT SYSTEM FOR EARLY WARNING ON INCREASED RISK OF SKIING INJURY OCCURRENCE – FIRST RESULTS 221
Marković Petar, Delibašić Boris, Suknović Milija
EUROPE 2020 STRATEGY – A MULTIVARIATE APPROACH 228
Milenković Nemanja, Đoković Aleksandar, Vukmirović Aleksandra
A FUZZY LOGIC-BASED SYSTEM FOR ENHANCING SCRUM METHODOLOGY 234
Stupar Mihailo, Milošević Pavle, Petrović Bratislav
APPLYING THE ANALYTIC HIERARCHY PROCESS TO RANK CITY-BRANCHES 241
Cvetkoska Violeta, Begicevic Redzep Nina

ELECTRONIC BUSINESS 255

E-BUSINESS START-UP MODELS 256
Malbašić Una, Surla Katarina
MEASURING DEMAND FOR IT SKILLS ON THE SERBIAN JOB MARKET 265
Vujović Stefan, Đorđević Valentina, Barać Dušan
TRENDS SHAPING BUSINESS MODEL INNOVATION IN TELECOMMUNICATION COMPANIES 270
Orlić Nenad, Vasković Vojkan
RESHAPING THE FUTURE OF BUSINESS PROCESS MANAGEMENT THROUGH SUSTAINABLE CONTENT MANAGEMENT SYSTEM 279
Milenkovic S. Dejan, Jovanovic Milenkovic Marina, Simonovic Dragoljub
STAKEHOLDER RELATIONSHIP MANAGEMENT IN E-BUSINESS OF LARGE ENTERPRISES 285
Milinović Suzana , Vasiljević Dragana, Despotović-Zrakić Marijana
IMPLEMENTATION OF QUALIFIED ELECTRONIC SIGNATURE IN THE PROCESS OF CREATING TECHNICAL DOCUMENTATION 297
Novarlić Miljana, Martać Rastko
MANAGEMENT INFORMATION SYSTEMS: E-LEARNING AT THE UNIVERSITY OF NOVI SAD 298
Marjanovic Ugljesa, Tasic Nemanja, Lalic Bojan
IMPLEMENTATION OF THE CROWDFUNDING CONCEPT IN HIGHER EDUCATION 304
Staletić Nada
ILS LEARNING STYLE MODEL AND MULTIMEDIA E-LEARNING 312
Radosavljević Vitomir, Mamula Tartalja Danica, Jelić Gordana
CRM MODEL IN E-BUSINESS FOR NON-COMMERCIAL ONLINE RADIO 318
Badovinac Nenad, Đorđević Katarina
WEB SITE INTEGRATION INTO ORGANAIZATIONAL STRUCTURE OF THE LOCAL TOURIST COMMUNITY 324
Vasković Jelena, Bačević Miloš
APPROACH TO COLLABORATIVE MICROLEARNINGBASED ON CROWDSOURCING 329
Zahirović Suhonjić Anida, Labus Aleksandra, Despotović-Zrakić Marijana
AUGMENTED REALITY AND MOBILE LEARNING 338
Štrbac Slavica, Grgurović Biljana, Radosavljević Vitomir
SEMANTIC MODEL FOR ADAPTIVE E-LEARNING SYSTEMS 345
Perišić Jasmina, Bogdanović Zorica, Đurić Igor
SUCCESS FACTORS FOR LUXURY BRANDS IN E-BUSINESS: BURBERRY CASE STUDY 354
Radisavljevic Tijana, Markovic Aleksandar
DIGITAL MARKETING AND SOCIAL MEDIA IN HIGHER EDUCATION 365
Vujin Jovana
ANALYSIS AND VALIDATION OF SUCCESS FACTORS OF MOBILE APPLICATIONS AS E-MARKETING TACTIC 372
Đurđević Natasa
E-SERVICES IN THE REGULATION OF MEDICINES AND MEDICAL DEVICES 380
Stojadinovic Tatjana, Vanevski Igor, Radovanovic Ljiljana
INTERNET OF THINGS IN E-HEALTH: APPLICATION OF WEARABLES FOR STRESS MANAGEMENT 387
Rodic Trmcic Branka, Labus Aleksandra, Radenkovic Bozidar
AN APPLICATION OF INTERNET OF THINGS: MEASURING TRAFFIC FLOW 396
Jezdović Ivan, Ivković Aleksandar, Matejić Sanja
INTELLIGENT PARKING SERVICE MODEL 402
Vuletic Predrag, Bojovic Zivko
AN APPLICATION OF TEXT TO SPEECH IN SMART HOME 408
Knežević Đorđe, Lošić Pavle, Bojović Živko
SMART BUILDING, THE NATIONAL BANK OF SERBIA 415
Bjelobaba Goran, Savić Ana
AMBIENT INTELLIGENCE TOOL FOR MULTIMEDIA USER PROFILING 424
Đurić Igor, Bogdanović Zorica, Radenković Božidar
USING BIG DATA ON LARGE DAMS 432

Martać Rastko, Novarlić Miljana, Barać Dušan
TRAFFIC FLOW WEB MONITORING BASED ON THE MONGODB 439
Zdravković Stefan, Vulović Nikola,Stanković Ranka
THE POTENTIAL OF BIG DATA IN HEALTH SYSTEM 446
Jovanovic Milenkovic Marina, Milenkovic Dejan, Vukmirovic Aleksandra
IMPROVING E-COMMERCE SYSTEMS WITH BIG DATA TECHNOLOGY 452
Stojić Nenad, Dacić-Pilčević Aleksandra
BIG DATA IN POSTAL TRAFFIC AND POSSIBILITIES OF USE 458
Dupljanin Đorđije, Dumnić Slaviša, Atanasković Predrag
COMPARATIVE OVERVIEW OF JAVASCRIPT FRAMEWORKS USED IN E-BUSINESS APPLICATIONS 464
Zdravković Dušan

ENTERPRENEURSHIP 475

ANALYSIS OF STAGES IN THE LIFE CYCLE OF FAMILY SMEs IN THE REPUBLIC OF SERBIA 476
Mihic Marko, Arsic Sinisa, Arsic Milos
ARGUMENTS FOR DESIGNING PROGRAMMES FOR ENCOURAGING THE YOUTH IN SERBIA TOWARDS ENTREPRENEURSHIP 484
Omerbegović-Bijelović Jasmina, Mirković Predrag, Rakićević Zoran
COMPANY'S GROWTH AS A RESULT OF ENTREPRENEUR'S CREATIVE ABILITIES 495
Peljko Žiga, Jeraj Mitja, Marič Miha
FEMALE ENTREPRENEURSHIP: MAIN CHALLENGES AND THE IMPACT OF GENDER GAP 504
Kokotović Dunja, Rakić Bogdan Kokotović Tijana
ORGANIZATION SPECIFICS OF SMALL AND MEDIUM ENTERPRISES WITH A SPECIAL OVERVIEW OF MARKETING FUNCTION 513
Vukmirović Valentina, Vukmirović Nikola
WOMEN'S ENTREPRENEURSHIP - A GLOBAL PERSPECTIVE AND CURRENT STATE IN SERBIA 522
Vrbanac Maja, Milovanović Marina, Perišić Jasmina

ENVIRONMENTAL MANAGEMENT 530

ACOMPLISHING GOALS OF TERTIARY ENVIRONMENTAL EDUCATION BY USING DEBATE AS AN EDUCATIONAL METHOD 531
Vignjević Milan, Ćirović Marko
AIR POLLUTANTS AND GREENHOUSE GASES 538
Senegačnik Marjan, Vuk Drago, Petrović Nataša
APPLICATION OF EU LEGISLATION AIMED AT PREVENTING MAJOR ACCIDENTS IN THE CONTEXT OF ENVIRONMENTAL PROTECTION 546
Kovačić Mirjana, Zekić Astrid, Dundović Čedomir
COMBINING LEAN AND GREEN IN LOGISTICS: A SURVEY OF LOGISTICS COMPANIES IN SLOVENIA 552
Pejić Vaska, Lisec Andrej
ENVIRONMENTAL MANAGEMENT AND SUSTAINABILITY: TRENDS AND PRACTICES 559
Borojević Tatjana, Senegačnik Marjan, Petrović Nataša
MULTIATTRIBUTE METHODS AS A MEANS FOR SOLVING LAKE POLLUTION PROBLEMS 565
Andrić Gušavac Bisera, Popović Milena, Katić Ana
REACHING ENERGY EFFICIENCY THROUGH ENVIRONMENTALLY RESPONSIBLE HARDWARE AND SOFTWARE DEVELOPMENT 572
Milekić Matija, Ćirović Marko, Petrović Nataša
SELECTION OF EFFICIENT LOCATIONS FOR MEDICAL WASTES INCINERATION PLANTS 577
Stanojević Kristina, Makajić Nikolić Dragana, Savić Gordana
SUSTAINABILITY OF THE FASHION INDUSTRY: HOW DOES THE YOUTH FEEL 585
Radaković Jelena Andreja, Pepić Marko, Stevanović Dejana
THE ATTITUDES OF ENVIRONMENTALLY EDUCATED STUDENTS ABOUT A NEW GLOBAL DEVELOPMENT AGENDA 590
Petković Jasna, Radaković Jelena Andreja

FINANCIAL MANAGEMENT 597

INTEGRATION AND REGIONAL POSITION OF STOCK MARKETS: A CASE OF SOUTH EAST EUROPEAN COUNTRIES 598
Radovanov Boris, Marcikić Aleksandra
IMPACT OF THE EFFICIENCY OF THE TAX ADMINISTRATION ON THE MACROECONOMIC STABILITY 604
Savić Gordana, Dragojlovic Aleksandar
PROGRAM BUDGETING OF LOCAL AUTHORITIES IN SERBIA – A TOOL FOR CITIZEN PARTICIPATION AND SUSTAINABLE DEVELOPMENT 611
Jovanović Vladimir, Knežević Snežana
HAS THE FINANCIAL CRISIS CHANGED THE RESEARCH AGENDA ON BANKING REGULATION AND SUPERVISION? 617
Dias Lopes Jose
AN APPLICATION OF NEURAL NETWORKS AND FUNDAMENTAL ANALYSIS FOR AUTOMATED TRADING: BELGRADE STOCK EXCHANGE CASE 626
Rakićević Aleksandar, Milovanović Ana, Aničić Rastko
PERFORMANCE OF EVENT-DRIVEN HEDGE FUNDS' STRATEGIES 635
Bogojevic Arsic Vesna

USING FINANCIAL STATEMENT DATA TO EXPLAIN STOCK PRICE MOVEMENTS – BELGRADE STOCK EXCHANGE CASE 644
Milovanovic Jovan, Mesic Teodora, Rakicevic Aleksandar
APPLYING A NEURO FUZZY SYSTEM FOR CREDIT RISK EVALUATION 650
Vranić Nevena, Đurić Javorka, Dragović Ivana
OPTIMIZATION OF ATM CASH MANAGEMENT 658
Milosevic Nela, Makajic Nikolic Dragana, Barjaktarovic Rakocevic Sladjana
DRIVERS OF HOTEL PROFIT MARGINS: A STUDY OF THE BELGRADE HOTEL SECTOR 665
Milosavljević Miloš, Milanović Nemanja, Benković Slađana
PROTECTION OF INTELLECTUAL PROPERTY RIGHTS - WHAT DO FINANCIAL REPORTS SAY? 673
Radovanovic Nikola, Dmitrovic Veljko, Knezevic Snezana
THE IMPORTANCE AND APPLICATION OF TRANSFER PRICING COMPLIANCE IN MODERN BUSINESS 678
Djurica Maja, Jovanovic Marko, Maric Miha

HUMAN RESOURCE MANAGEMENT 688

E-RECRUITMENT: THE USE OF CONTEMPORARY TECHNOLOGIES FOR MANAGING TALENTS 689
Anđelković Labrović Jelena, Milosavljević Gordana
"JOHARI`S BEERGAME": THE EFFECT OF ALTERING COOPERATIVENESS IN SUPPLY CHAIN 694
Panić Biljana, Kovačević Ivana, Vujošević Mirko
HUMAN RESOURCES AS THE INITIATOR OF HIGH VALUE ENVIRONMENTAL PERFORMANCES OF LOCAL GOVERNMENTS OF THE REPUBLIC OF SERBIA 701
Nikolić Neda, Paunović Vladan, Dabetić Djordje
FORMER SOLDIERS' ATTITUDES TOWARDS ACTIVE RESERVE SERVICE 708
Nikolic Nebojsa
THE MAIN MOTIVATING FACTORS FOR SOMEONE TO TAKE UP ENTREPRENEURSHIP 713
Milinković Ivana, Kovačević Ivana, Mihailović Dobrivoje
IMPACT OF HUMAN RESOURCE MANAGEMENT ON ORGANIZATIONAL PERFORMANCE 720
Stanojević Dražena
SPIRAL DYNAMICS AS VALUE SYSTEM AND COMPETITIVE ADVANTAGE OF AN ORGANIZATION 725
Rodic Dusanka
MILLENNIALS IN THE WORKPLACE 733
Ivancevic Sonja, Ratkovic Tatjana
WHAT EVER HAPPENED TO THE CONCEPT OF HR BUSINESS PARTNERSHIP? SOME EVIDENCE ON FIRMS OPERATING IN SERBIA 737
Stefanović Ivan
WFMS AS THE FOUNDATION OF BUSINESS PROCESS IMPROVEMENT: HUMAN RESOURCE MANAGEMENT PERSPECTIVE 745
Minić Nemanja, Lukić Marija, Savić Milica

ICT AND MANAGEMENT 754

COMPARATIVE ANALYSIS OF SCRUM AND KANBAN METHODOLOGIES FOR MANAGING INFORMATION SYSTEMS DEVELOPMENT 755
Pantelić Ognjen, Gajić Vedrana, Pajić Ana
APPLICATION OF MULTIMODAL BIOMETRICS IN ACCESS CONTROL SYSTEMS 762
Milenković Ivan, Živković Ksenija, Simić Dejan
OVERVIEW OF EAR BASED PERSON RECOGNITION ALGORITHMS 771
Krneta Sofija, Šošević Uroš, Starčević Dušan
PREVENTION OF FRAUD IN ELECTRONIC PAYMENT SYSTEMS 778
Bogićević Sretenović Marija, Petković Jasna, Jovanović Bojan
CASH, HASH OR TRASH - HASH FUNCTION IMPACT ON SYSTEM SECURITY 788
Zivadinovic Milos, Milenkovic Ivan, Simic Dejan
GIS IN BUSINESS MANAGEMENT 792
Kranjac Mirjana, Sikimić Uroš, Tomić Srđan
PROSPECTS AND TRENDS IN THE DEVELOPMENT OF TELEMEDICINE 799
Jovanovic Milenkovic Marina, Milenkovic Dejan, Ristic Slobodan
MODEL-DRIVEN APPROACH TO THE IMPLEMENTATION OF WEB SERVICE INTERFACES FOR 4GL SYSTEM 805
Vesić Slavimir, Aničić Nenad, Babarogić Slađan

INTERNATIONAL MANAGEMENT 815

GAINING COMPETITIVE ADVANTAGE IN INTERNATIONAL BUSINESS ENVIRONMENT THROUGH SMART PRODUCTS AND SERVICES DEVELOPMENT 816
Backović Nemanja, Milićević Vesna, Ilić Bojan
INTERNATIONAL SOURCES OF FUNDING ECONOMIC DEVELOPMENT 824
Jednak Sandra, Pareżanin Miloš, Kragulj Dragana
TRANSFER PRICES - AN INSTRUMENT FOR BOOSTING COMPETITIVENES OF MULTINATIONAL ENTERPRISES 832
Popovčić-Avrić Snežana, Šestović Marina, Todić Tamara
ROMANIA AND SERBIA – SIMILARITIES AND MAJOR DEVIATIONS FROM THE STATISTICAL PROFILE OF A GENERIC BALKAN ECONOMY 838
Săvoiu Gheorghe, Taicu Marian, Čudanov Mladen

INTERNATIONAL TECHNOLOGY TRANSFER AND SPILLOVERS IN MERGERS AND ACQUISITIONS 847
Kijanović Nemanja
OVERVIEW OF AIRLINE FLEET OWNERSHIP STRUCTURE 854
Dožić Slavica, Krnić Radovan

KNOWLEDGE MANAGEMENT 864

TRANSNATIONAL R&D COOPERATION AND BARRIERS TO COOPERATION IN THE DANUBE REGION – SERBIA CASE 865
Semenčenko Dušica, Živković Lazar, Kutlača Đuro
COMPETENCY OF REGISTERED FARMERS FOR INDEPENDENT BUSINESS* 873
Miladinović Slobodan, Ljiljanić Nikola

MARKETING MANAGEMENT 881

PARTICIPATION IN ONLINE MARKETING RESEARCH PANELS: FINDINGS FROM FOCUS GROUP DISCUSSIONS 882
Ljepava Nikolina, Janičić Radmila
EFFECTS OF INDIRECT ADVERTISING IN VIDEO GAMES: ADVERTISERS' AND PLAYERS' PERSPECTIVE 889
Štavljanin Velimir, Kostić-Stavković Milica, Cvijović Jelena
ATTITUDES TOWADS INDIRECT ADVERTISING IN TV SERIALS 893
Kostić - Stanković Milica, Cvijović Jelena
IMPROVEMENT OF SERVICE ENVIRONMENT AT POSTAL NETWORK UNITS 898
Jovanović Bojan, Šarac Dragana, Kujačić Momčilo
OPTIMIZATION OF LOCAL PRINT MEDIA BUSINESS IN THE CONDITIONS OF TURBULENT ENVIRONMENT 806
Bubnjević Dalibor
GASTRONOMIC FESTIVALS AS A FORM OF BRANDING SERBIA AS A TOURIST DESTINATION 913
Vukic Milena, Kuzmanovic Marija, Vukic Ksenija
MARKETING AND SUSTAINABLE DEVELOPMENT 920
Jović Marija, Novčić Branka
SUSTAINABLE DEVELOPMENT OF STRATEGIC BRAND PARTNERSHIP 926
Vasilic Slobodan, Milosev Dejana
SPONSORSHIP OF SPORTS EVENTS AS A MARKETING TOOL 933
Petrović Mila, Vučinić Jelena
INNOVATIVE APPROACH TO ONLINE MARKETING FOR BOOK PUBLISHERS 940
Prtenjak Milan

OPERATIONS MANAGEMENT 946

TRACKING OF KEY PERFORMANCE INDICATORS BY USING CONTROL CHARTS: CASE OF OEE STABILIZATION 947
Vasić Danko, Gregec Nikola, Rakićević Zoran
A NOVEL ALGORITHM FOR COMBINATORIAL PROBLEM IN MANUFACTURING CELL FORMATION 954
Danilović Miloš, Ilić Oliver
APPLICATION OF MODERN CONTROL THEORY TO INVENTORY CONTROL IN PHARMACEUTICAL DISTRIBUTION COMPANY 962
Đorđević Lena, Antić Slobodan
STATIC CODE ANALYSIS AND REPORTS BASED APPROACHES FOR SPREADSHEET ERRORS DETECTION 970
Živić Miloš, Đorđević Lena, Lečić-Cvetković Danica
AN OPTIMIZATION-SIMULATION APPROACH TO ADVERTISEMENT PLACEMENT PROBLEM 978
Marković Stefan, Vujošević Mirko
RATIONALIZATION OF STORAGE COSTS BY APPLICATION OF MODIFIED SMED METHOD 986
Milanovic Dragan, Nestorov Aleksandar, Misita Mirjana
KEY PERFORMANCE INDICATORS AND PRICING STRATEGIES PLANNING IN RETAIL INDUSTRY 995
Radonić Milenko, Đorđević Vedrana, Omerbegović-Bijelović Jasmina
OPEN SOURCE ENTERPRISE RESOURCE PLANNING: SOLUTION FOR PRODUCTION PLANNING IN SMEs 1003
Rakićević Zoran, Omerbegović-Bijelović Jasmina, Lečić-Cvetković Danica
GPI PROCESS PERFORMANCE MEASUREMENT MODEL 1011
Simeunović Barbara, Slović Dragoslav, Radović Milić
DETERMINATION OF FAILURE DISTRIBUTION PARAMETERS FOR BANBURY MACHINE 1020
Şirin Aydın M., Güney Baha, Teke Çağatay
OVERALL ORGANIZATIONAL PERFORMANCE: A NOTE ON FIRMS OPERATING IN THE WESTERN BALKANS REGION 1027
Stefanović Ivan, Marčetić Nenad
IMPROVING EFFICIENCY OF ENGINEER-TO-ORDER OPERATIONS THROUGH LEAN IMPLEMENTATION: EMPIRICAL RESEARCH 1036
Tomašević Ivan, Slović Dragoslav, Stojanović Dragana
TOWARDS SUSTAINABILITY: MASS CUSTOMIZED-LEAN-AGILE-FIT OPERATIONS MANAGEMENT IN BANKING 1045
Tornjanski Vesna, Marinković Sanja, Jančić Željka
APPLICATION OF THE GAMES IN TEACHING LOGISTICS AND SUPPLY CHAIN MANAGEMENT IN THE REPUBLIC OF SERBIA 1056
Cvetić Biljana, Milenković Nemanja

PROJECT MANAGEMENT 1065

COMPETENCES OF THE PROJECT MANAGERS IN RELATION TO THE TYPE OF PROJECT 1066
Petrović Dejan, Mihić Marko, Obradović Vladimir

KNOWLEDGE SHARING IN PROJECT ENVIRONMENT 1074
Todorović Marija, Toljaga-Nikolić Danijela, Mitrović Zorica

MATURITY MODEL COMPARATIVE ANALYSIS: OPM3 VS. IPMA DELTA MODEL 1081
Bjelica Dragan, Mitrović Zorica, Todorović Marija

SUSTAINABILITY AND PROJECT MANAGEMENT – WHERE IS THE LINKAGE? 1088
Toljaga-Nikolić Danijela, Todorović Marija, Bjelica Dragan

PUBLIC ADMINISTRATION MANAGEMENT 1095

THE PROCESS OF DECISION MAKING AT LOCAL LEVEL; BASED ON THE MODEL OF THE CITY MUNICIPALITY OBRENOVAC 1096
Ašković Bojana

PUBLIC SERVICE INTERFACE SOLUTION BASED ON BACK OFFICE INTERCONECTION FOR E-GOVERNMENT DEVELOPMENT: A MACEDONIAN CASE STUDY 1102
Bogdanoska Jovanovska Mimoza, Blazevska-Tabakovska Natasa, Vlahu-Gjorgievska Elena

INSTITUTIONALISM AND ORGANISATIONAL LEARNING IN THE PUBLIC PROCUREMENT MARKET 1108
Jaško Ondrej, Čudanov Mladen, Savoiu Gheorghe

EMBRACING THE OPEN DATA INITIATIVE IN REPUBLIC OF SERBIA 1116
Vidojević Branislav, Milčić Marija

DEVELOPMENT OF SYSTEM FOR COORDINATE AND EFFICIENT RESPONSE TO CYBER INCIDENTS 1125
Jovanovic Svetlana, Drakulic Mirjana, Vucenovic Tamara

RESEARCH IN THE FUNCTION OF IMPROVEMENT OF PUBLIC PROCUREMENT LAW 1133
Vukmirović Jovanka, Jovanović Predrag, Vukmirović Dragan

QUALITY MANAGEMENT 1143

PERCEPTION OF BENEFITS - GUIDELINES FOR THE APPLICATION OF ISO 9001:2015 1144
Cice Jelena, Pribićević Ivan, Kočijašević Strahinja

PARADIGM EVOLUTION: FROM LINEARITY TO COMPLEXITY IN THE WORLD OF QUALITY MANAGEMENT 1154
Borisavljević Miloš, Nedeljković Miloš, Đurić Mladen

SOME TERMINOLOGICAL OBSERVATIONS ON ISO 9000 STANDARD SERIES WITH SPECIAL FOCUS ON ISO 9000:2015 1160
Đordan Andrijana, Jakić Gordana, Anđelković Jelena

QUALITY COSTS IN THE MANAGEMENT SYSTEM IN THE FIELD OF HIGHER EDUCATION 1167
Zivkovic Nedeljka

DOCUMENTING PROCESSES: CHALLENGES FOR FIRMS OPERATING IN SERBIA 1176
Momčilović Marina, Stefanović Ivan

QUALITY MANAGEMENT AND INFORMATION: FROM STAKEHOLDERS REPORTING TO MEDIA PIONEERING QUALITY 1183
Jakovljević Tamara, Čobrenović Ana, Ranković Biljana

HOLISTIC APPROACH TO CONSULTING FOR QUALITY SYSTEM AND OTHER MANAGEMENT SYSTEMS 1190
Trajković Ana, Mihić Branimirka

FMEA APPLICATION IN RISK MANAGEMENT AS RESPONSE TO THE ISO 9001:2015 REQUIREMENTS 1198
Markovic Sanja, Ruso Jelena, Horvat Ana

QUALITY OF SOCIAL RESPONSIBILITY ACTIVITIES AND STAKEHOLDERS NEEDS IN SERBIAN EDUCATIONAL INSTITUTIONS 1205
Lukić Bojana, Glogovac Maja, Živković Nedeljko

WHO IS GOING TO BE MORE INTERESTED IN ISO 50001 CERTIFICATION? 1213
Kandić Sanja

THE ROLE OF HIGHER EDUCATION IN BUILDING AND IMPROVING NATIONAL QUALITY INFRASTRUCTURE – THE CASE OF SERBIA 1220
Ruso Jelena, Filipović Jovan, Pejović Gordana

THE ROLE AND THE PERCEPTION OF THE STANDARD ISO 22000 1225
Jovanović Luka, Ilić Milica, Đurić Mladen

INNOVATIVE STRATEGIES FOR NEW COMPETENCE DEVELOPMENT – BRINGING THE REAL WORLD IN HIGHER EDUCATION 1235
Mijatovic Ivana, Damnjanovic Vesna

SOFTWARE QUALITY ASSURANCE 1242
Marković Sara, Stojanović Katarina, Đurić Mladen

SOFTWARE ENGINEERING 1252

GENERAL CONCEPT OF THE PLATFORM INDEPENDENCY MODEL 1253
Vlajić Siniša, Antović Ilija, Savić Dušan

DEVELOPING ANDROID APPLICATION FOR LEARNING DATABASE DESIGN 1263
Lazarević Saša, Stanišić Igor

COMPARATIVE ANALYSIS OF UML MODELING TOOLS WITH FOCUS ON BUSINESS LOGIC SPECIFICATION 1272
Stanojević Vojislav, Lazarević Saša, Milić Miloš

A POSSIBLE APPROACH TO AUTOMATING THE DESIGN OF NOSQL DOCUMENT-ORIENTED DATABASES 1281
Stojimirović Dejan, Nešković Siniša, Turajlić Nina

STRATEGIC MANAGEMENT 1290

INTEGRATED PERFORMANCE MANAGEMENT FROM A UNIVERSITY PERSPECTIVE 1291
Skoog Matti, Vesovic Vladimir
FRAMEWORK FOR STRATEGIC PERFORMANCE MANAGEMENT IN THE MEDIA INDUSTRY 1296
Marić Nataša, Obradović Vladimir and Cicvarić Kostić Slavica
DEVELOPMENT AND TRENDS IN THE MANAGEMENT CONSULTING INDUSTRY 1305
Krivokapić Jovan, Savić Milica, Čudanov Mladen
APPLYING A GENERAL MORPHOLOGICAL ANALYSIS IN LONG-TERM DEFENCE PLANNING PROCESS 1312
Kankaraš Milan, Stojković Dejan, Lojić Ranko
PROGNOSTIC RESEARCH IN THE FUNCTION OF STRATEGIC DEFENSE PLANNING 1319
Blagojević Srđan, Ristić Vladimir, Bojanic Dragan
ON METHODOLOGICAL APPROACHES TO DEFENCE SECTOR REFORM 1325
Nikolic Nebojsa
STRATEGIC PERFORMANCE MANAGEMENT SYSTEM IN PUBLIC SECTOR: THE ROLE OF KNOWLEDGE MANAGEMENT 1331
Mitrović Zorica, Bjelica Dragan, Toljaga Nikolić Danijela
THE SIGNIFICANCE OF THE PARADIGM OF GRADUAL EVOLUTION FOR THE DEVELOPMENT OF THE DEFENCE SYSTEM 1339
Ristic Vladimir, Blagojević Srdjan
ANALYSIS OF POSTAL MARKET AS A PRECONDITION DEFINING THE MODEL ACCESS TO POSTAL NETWORK IN REPUBLIC OF SERBIA 1346
Unterberger Marija, Šarac Dragana, Ožegović Spasenija
MEASURING SECURITY MANAGEMENT PERFORMANCE 1354
Bojanic Dragan
MILLENNIALS AS A FUTURE DOMINANT WORKFORCE- STRATEGIC FRAMEWORK FOR UNDERSTANDING AND CREATING CHALLENGING ENVIRONMENT 1359
Ilić Tanja, Pavićević Milica

SUSTAINABLE BUSINESS DEVELOPMENT 1367

SUSTAINABLE DEVELOPMENT AS AN ALTERNATIVE SOCIETY OF THE FUTURE 1368
Žnidarič Davorin
SUSTAINABLE TECHNOLOGY AND BUSINESS INNOVATION PRINCIPLES – A COMPREHENSIVE APPROACH 1374
Levi Jakšić Maja, Rakićević Jovana, Jovanović Milica
CORPORATE SOCIAL RESPONSIBILITY: PHILANTHROPY, OBLIGATION OR UTILITARIANISM? 1382
Stojanović-Aleksić Vesna, Bošković Aleksandra
THE IMPORTANCE OF ETHICS OF THE BUSINESS ORGANIZATIONS FOR SUSTAINABLE BUSINESS DEVELOPMENT 1389
Erić Ivana
CONSISTENCY OF THE EUROPEAN COMMISSION'S ASSESSMENT OF PROPOSED MERGERS IN AIRLINE SECTOR 1396
Babić Danica, Pavlović Dejan
THE UPRISE OF THE MIDDLE EAST CARRIERS – EMIRATES' PATH TOWARDS SUCCESS 1405
Kuljanin Jovana, Kalić Milica

TECHNOLOGY AND INNOVATION MANAGEMENT 1414

TECHNOLOGY STATUS AND COMPETITIVENESS OF SERBIAN MANUFACTURING INDUSTRY 1415
Štrbac Dijana
GLOBAL ELECTRONIC MARKET IN THE FUNCTION OF RETAILERS INTERNATIONALIZATION 1422
Končar Jelena, Petrović Katai Zita, Leković Sonja
THE CONCEPT OF HYBRID METHOD FOR RISK ASSESSMENT IN NEW PRODUCT DEVELOPMENT 1428
Milutinović Radul, Stošić Biljana
INDEX OF POTENTIAL FOR TECHNOLOGY ENTREPRENEURSHIP DEVELOPMENT: PRACTICE FROM SERBIA 1436
Rakićević Jovana, Levi Jakšić Maja, Jovanović Milica
USE OF MODERN TECHNOLOGY IN HOTEL ORGANISATION: THE INFLUENCE OF INFORMATION TECHNOLOGY ON HUMAN FACTOR 1442
Jovanović Olga, Savoiu Gheorghe
POTENTIAL IMPACT OF 3D PRINTING IN REDESIGNING SUPPLY CHAIN - EXAMPLE OF MEDICALINDUSTRY 1449
Rakić Bogdan, Ratković Aleksandra, Mrvić Jovana
SUPPORTING DEVELOPMENT OF TECHNOLOGICAL STARTUPS THROUGH MENTORING 1457
Okanović Milan, Anđelković Labrović Jelena, Stefanović Tijana
EVALUATION AND SELECTION OF TECHNOLOGY STRATEGIES USING QUANTITATIVE STRATEGIC PLANNING MATRIX 1465
Jevtić Milica, Demirović Ranko, Marinković Sanja
OPPORTUNITIES AND THREATS OF GLOBAL TECHNOLOGY AND OPERATIONS STRATEGY IN OIL AND GAS INDUSTRY 1474
Sekulović Ivan
DEVELOPMENT OF A NEW PROJECT 1483
Mišković Zorana, Milinković Ivana

INVITED PAPERS

(RE)SHAPING OR ESCAPING THE FUTURE? ATRANSDISCIPLINARY PERSPECTIVE ON SUSTAINABLE DEVELOPMENT AND THE ROLE OF BUSINESS

Adriana Budeanu
Department of International Economics and Management (INT)
Center for Leisure and Culture Studies (CLCS)
Copenhagen Business School, Denmark

Abstract: *Examining and discussing the role of business and entrepreneurship in the context of sustainable development is an ambitious task. This expose takes a starting point in acknowledging that business development is essential to any goal associated to the future of humanity, while at the same time, sustainable development has given way to a veritable market transition. In fact, it is suggested thatsustainable consumption and social equity are becoming key goals for business strategy (Porter & Kramer, 2011) next to profitability and competitiveness. The emergence of social entrepreneurship, socially responsible investments and philantro-capitalism are illustrative examples of an acclaimed paradigm shift in business philosophy, where profitability is embedded and aligned with society's well-being.*

In his book "From heresy to Dogma", Andrew Hoffmann makes a historical analysis of corporate reactions and positions towards sustainability-relevant matters, such as environmental goals, to conclude that businesses have become an equal partner in the negotiations that aim to definesuch goals(Hoffman, 2001). So much so, that businesses involvement is often comparable with the role of states in shaping society's path towards the future(Halme, Park, & Chiu, 2002).This is also illustrated by the constant preoccupation of political, cultural and (recently) spiritual leaders who speak of the role, interest and responsibility of businesses for the well-being of humanity. The subject of business involvement in sustainable development enters other spheres of everyday lifealso. As individuals, we are now citizen-consumers and have the option of 'voting with our wallets'to encourage businesses that make significant and genuine efforts to offer sustainable products and services, such as organic food or renewable energy. To make our choice easier, specialized organizations develop ranking systems that inform and educate while convincing us that businesses have – to different degrees – a genuine interest in encouraging sustainable consumption. At the same time, the trustworthiness of sustainable businessactions is a frequent subject in mass media, albeit mostly when is highly controversial, as for example in the recent case of Volkswagen(Milne, 2015). But while a few (mostly the same) companies make headlines, the majority remains silent and only occasionally engages in the field of sustainable development. In Hoffman's perspective, businesses' active (sometimes aggressive) interest in shaping political and social debates about sustainable development is a natural way for preserving their future relevance. Then it is reasonable to ask – and rightly so - why is progress so slow, and insufficient in practice?

In his argument, (Hoffman, 2001) brings up a keyparadox embedded in the definition given by the World Commission of Economic and Development to sustainable development as "the development that meets the needs of the present without compromising the ability of future generations to meet their own needs"(UNWCED, 1987). This definition is extremely important for introducing a new moral obligation for social responsivenessto nations and individuals alike (Solow, 1991). But at the same time, this definition posits the assessment of success into the future, a time and space for which we lack unbiased evaluations. The absence of objective proof enables the emergence of multiple representations of a future for humanity, of which many gravitate around utopian or dystopian views.Utopian descriptions of the future assume that humanity will prevail in achieving sustainability, primarily by eliminating un-sustainable practices known today (e.g. distributional inequity, intensive resource consumption, etc). The focus in such views is primarily on integrating desirable objectives from all groups involved,with little concern of their (sometimes) contradictorygoals. The resulting integrated models are accompanied by intricate sets of conditions that often inhibit

chances for implementation. In contrast, dystopian views describe a doomed hellish future, with an apocalyptic environment (severe climate, insufficient resources, horrifying natural disasters and profound social turbulence) adverse to human survival. Faced with an apparent choice, actors can, and seem entitled to,act to avoid apocalyptic futures at all costs, under a high sense of urgency enhanced sometimes by scientifically calculated 'deadlines'. Obedient in many respects, we aim to tame the unknown future by defining, measuring and designing measures to avoid it. Butas long asestimations of future needs remain uncertain, visions for a sustainable humanity result in actions thatreduce un-sustainability aspectsbut lead only to occasional true progress (Ehrenfeld, 2004).

Referencingvisions of humanity's future, in all its complex and dynamic socio-technical, cultural and economical dimensions, gives way to multiple interpretations of meanings, symbols and imaginaries that shape social reality (Baptista, 2012) and arguments for prioritization often end with no prospects for progress. At the same time, uncertainties embedded in operating (or trying to) the notion of 'the future' open up possibilities for opportunistic behavior by individual actors. And many concepts emerging from the definition of sustainable development seem to converge towards institutional and group prerogatives at the expense of traditional beliefs and practices (Mebratu, 1998). Perhaps, instead of taking a starting point in defining 'what' is sustainable development, we could start by asking 'how' to make progress by ensuring that all social groups concerned with the future are involved in negotiations and the decisions that construct it. In this scenario, focus on delineating the parameters of the future is replaced by the intent to create possibilities for humans and all forms of life on Earth to 'flourish' (Ehrenfeld, 2004).This alternative allows for the creation of a new intellectual space where new questions about 'what' sustainable development could be, and 'who' would be the actors building it, can emerge and be addressed. Using examples of urban sustainability projects (involving but not restricted to tourism initiatives), this presentation aims to formulate such questions and starting discussing the conditions under which sustainable futures may be (re)shaped or maybe escaped? By inquiring 'who' can participate in imagining a sustainable development, the presentation will also reflect on the role for business and entrepreneurship in designing our future.

REFERENCES

Baptista, J. A. (2012). The ideology of sustainability and the globalization of a future. Time & Society, 23(3), 358–379.

Ehrenfeld, J. R. (2004). Searching for sustainability: No quick fix. Reflections, 5(8), 1–13.

Halme, M., Park, J., & Chiu, A. (2002). Managing Globalization for Sustainability in the 21st Century. Business Strategy and the Environment, 11(2), 81–89.

Hoffman, A. J. (2001). From Heresy to Dogma: An Institutional History of Corporate Environmentalism. Stanford University Press. Retrieved from https://books.google.com/books?hl=en&lr=&id=xFq-uHlGhtwC&pgis=1

Mebratu, D. (1998). Sustainability and sustainable development. Environmental Impact Assessment Review, 18(6), 493–520.

Milne, R. (2015). Volkswagen: System failure. Financial Times. Retrieved from http://www.ft.com/cms/s/0/47f233f0-816b-11e5-a01c-8650859a4767.html

Porter, M. E., & Kramer, M. R. (2011). Creating shared value. Harvard Business Review, 89(1/2), 62–77.

Solow, R. M. (1991). Sustainability: An Economist's Perspective. Economics of the Environment Selected Readings. Retrieved from http://www.isites.harvard.edu/fs/docs/icb.topic203569.files/Solow.Sustainability_An_Economists_Perspective._1993.pdf

UNWCED. (1987). Our Common Future. Oxford paperbacks.

DESIGN THINKING APPROACH TO ETHICAL (RESPONSIBLE) TECHNOLOGICAL INNOVATION

Ganesh Nathan
University of Applied Sciences and Arts Northwestern Switzerland, Business School Lausanne (BSL), Switzerland

Abstract: *There is growing interest and importance for responsible research and innovation (RRI) among academic scholars and policy makers, especially, in relation to emerging technologies such as nanotechnology. It is also to be noted, although design thinking approach has been around since 1960s, there is renewed interest in this approach to innovation with increasing number of related publications over the last couple of decades. It is also currently introduced in a number of schools and community projects. This paper attempts to show that design thinking approach is potentially conducive to ethical (responsible) innovation due to its emphasis on human centred design.*

This paper first introduces why we should be concerned about ethical aspects of technological innovation. Then it shows why these problems pose challenges and constraints to address them. Following this section, it discusses about the shortcomings of linear innovation process models and introduces an improved circular innovation process model to embed ethical decision-making taking into consideration both internal and external stakeholders and networks at organizational level. However, many emerging technologies may introduce ethical issues at machine level; for example: autonomous vehicles, drones and next generation robotics. These concerns have been increasingly addressed by the emerging new field of machine ethics. However, it is important to integrate both ethical-decision making at organizational level on innovation process and machine ethics. From this perspective, this paper introduces design thinking approach to innovation and attempts to demonstrate that it is potentially conducive to ethical (responsible) technological innovation. It concludes with potential benefits and challenges with some directions for further research.

'Technologies can be not only contentious – overthrowing existing ways of doing things – but also morally contentious – forcing deep reflection on personal values and societal norms' (Cole & Banerjee, 2013; quoted in Nathan, 2014). Technological innovations can have undesirable consequences for society and environment. Just to give some examples: DDT as pesticide; the pharmaceutical thalidomide, prescribed as morning sickness treatment for pregnant women; chlorofluorocarbons (CFCs) used as refrigerants and propellants; etc. (Bessant, 2013; Nathan, 2014). These examples illustrate that organizational level decision-making during innovation process can have impacts on the linkages at macro level towards the market within socio-cultural-political-ecological context (see Hanekamp, 2010; Nathan, 2014). Furthermore, it is plausible to argue that many innovation decision-making processes have been blind to ethical impacts and concerns – 'innovation ethical blindness' (Nathan, 2014) and these can have economic impacts as well. For example, the Dutch government had to cancel the EPRS (Electronic Patient Record System) due to unresolved privacy issues after the investment of 300 million Euros over a 15-year period and the initiative to introduce smart electricity meters in every household within the Netherlands was also rejected by the upper house of the Dutch parliament due to privacy concerns after some years of R&D efforts (Van den Hoven, 2013; also Nathan, 2015). From social constructivism perspective, reality is socially constructed and technological innovations shapes this reality; however, this reality raises many ethical concerns and dilemmas Nathan, 2014). For example, social media raises ethical issues of cyber bullying and infringement on privacy and installation of surveillance cameras in public places introduces ethical dilemma of public safety versus privacy concerns. Technological innovations can be supportive to new constructive possibilities or can be exploitative for destructive purposes by actors within the technological field; for example, 3D printer can be used for reconstructive surgery and to make prototypes for architectural designs; however, 3D printer could also be used to print hand guns. Therefore, it is also important to consider moral contestation through exploitation that can have impacts on other intersecting fields (Cole & Banerjee, 2013; Nathan, 2014). Emerging technologies in many forms can introduce ethical concerns and dilemmas that are predictable as well as most critically less predictable ones (Matter, 2011; Nathan, 2014 & 2015). These emerging

technologies such as ICT and nanotechnology can converge into new forms of converging technologies such as nanomedicine and nanopharmacy that may introduce ethical dilemmas and concerns; these may be hard to predict at the early stages of innovation and to resolve them at later stages (Nathan, 2015). These new forms of technologies may raise some fundamental ethical questions such as how we should understand human identity and dignity. The above examples lead us to ask: what are the challenges and constraints in addressing these ethical concerns?

Some of the problems may be considered as wicked problems. These are ill-formulated or ill-structured with confusing information along with contradicting or conflicting values among those stakeholders such as decision-makers and customers or end users; moreover, requirements may be changing and dynamic and therefore ramifications can be confusing (Buchannan, 1992). Furthermore, it is also complicated with Collingridge dilemma; as already briefly mentioned, some of the ethical concerns and dilemmas may not be obvious and predictable at the early stages of innovation process and by the time they become clearer, it may be too late to remedy them due to technological lock-in (Collingridge, 1980; Nathan, 2015). Another challenge that one may face is moral overload; even if one identifies those ethical dilemmas it may be difficult to resolve those conflicting moral obligations or values or to implement them at the same time (Van den Hoven, 2013; also Nathan, 2015). So the next question is what sort of innovation process models may be suitable to address the above mentioned challenges and constraints?

There are variety of innovation process models such as traditional –stage-gate and funnel phased approach– as well as open innovation model; however, these are all linear innovation process models (Nathan, 2015). These models simplify complex innovation processes in order to emphasize critical innovation elements and stages. A simplified innovation process model consists of critical stages: searching for innovation opportunities, selecting the most suitable or viable ones and then implementing them for capturing the benefits in the market (Tidd and Bessant, 2009 & 2013). However, it is a linear progressive stage model that may not be suitable for wicked problems that require iterations with progressive and regressive processes. Furthermore, these models do not explicitly integrate ethical-decision making at each stage to identify potential ethical concerns and dilemmas among various stakeholders. Most importantly, as it is a linear open ended model, there is no explicit feedback loop to capture any unpredictable ethical concerns as early as possible following the launch of products and services in order to re-evaluate and take back these issues through the innovation process stages to rectify and to re-launch or to terminate those products or services (see Nathan, 2015). However, this simplified model could be modified as a circular innovation process model embedding ethical decision-making incorporating internal and external stakeholders at the organizational level (Nathan, 2015). A stakeholder map identifying all stakeholders, their interests along with ethical concerns and dilemmas as well as their rights and responsibilities may enable us to embed ethical decision-making within the innovation process at the organizational level; this framework could also integrate multiple perspectives and systems thinking approach (Nathan, 2015).

However, new forms of emerging and converging technologies may be problematic to embed moral code into intelligent autonomous machines such as drones, next generation robots and autonomous transport vehicles. These problems have fostered growing interest in the emerging field of machine ethics over the last decade (Anderson & Anderson, 2006). Building ethical robots is a challenge; embedding rule based ethical decision-making in predictable situations may not be effective in unpredictable situations and enabling machine-learning to make ethical decisions in new situations may create a problem of trust (Deng, 2015).

Against the above background, this paper attempts to explore the potential application of design thinking approach. Design thinking has been around since 1960s. However, design movement evolution can be traced back to 1980s with cognitive reflections towards user centred design to service design towards human centred design in 2000; from 2010 onwards, the movement has evolved to design thinking with approaches to experience design and creative class (Curedale, 2013). Design thinking may be understood in many different ways with some core attributes; there is no single definition for design thinking and in fact defining design thinking may defeat the very essence of it. The core elements of design thinking approach to innovation are technology, business and most importantly human. It is not about consumer or customer centred; rather it is about human centred and from this perspective it is not about existing or target customers. Therefore, it can also take into consideration potential new customers. However, I would add that

these need to be contextualized within the social and ecological environment as these elements invariably interact with the environment and ethical concerns may arise due to these interactions. IDEO has popularized design thinking to innovation with a simplified model consisting of six critical elements: understand, observe, point of view, ideate, prototype and test with iterative feedback processes. The core attributes of design thinking approach are: ambiguity, collaborative, constructive, curiosity, empathy, holistic, iterative, non-judgemental and open mindset (Curedale, 2013). It appears that some of these core attributes may be conducive to address the ethical problematic context. These core attributes are integrated with certain design thinking principles such as: action oriented, comfortable with change, human centric, integrates foresight, a dynamic constructive process, promotes empathy, reduces risks and creates meaning (Mootee, 2013). Again, we can see that these principles appear to be conducive to address ethical challenges to technological innovation.

Design thinking approach could be integrated with multiple perspectives and system thinking approach to embed ethical decision-making. This paper attempts to show that this path could potentially address ethical challenges in technological innovation and provides some directions for further research.

***Keywords**: design thinking approach, machine ethics, emerging and converging technologies, ethical decision-making, innovation process, technological innovation, ethical (responsible) innovation*

REFERENCES

Bessant, J. (2013). Innovation in the Twenty-First Century, Responsible Innovation, eds. R. Owen, J. Bessant & M. Heintz, UK: John Wiley & Sons, Ltd.

Cole, M. B. & Banerjee, M. P. (2013). Morally Contentious Technology-Field Intersections: The Case of Biotechnology in the United States, Journal of Business Ethics, 115:555-574.

Collingridge, D. (1980). The social control of technology. Francis Pinter Ltd, London, UK.

Curedale, R. (2013). Design Thinking: Process and Methods Manual, CA: Design Community College Inc.

Deng, B. (2015). Machine ethics: The robot's dilemma, Nature; accessed: http://www.nature.com/news/machine-ethics-the-robot-s-dilemma-1.17881

Hanekamp, G. (2010). Business Ethics of Innovation. An Introduction, Business Ethics of Innovation, ed. G. Hanekamp. Germany: Springer.

Matter (2011), A Report on responsible Research & Innovation, Brussels.

Mootee, I. (2013). Design Thinking for Strategic Innovation, NJ: Wiley.

Nathan, G. (2014). Technological innovation and ethics. In: Bastos, J.-C. and C. Stuekelberger (eds.) Innovation ethics: African and global perspectives. Globethics.net series 'Global', pp. 37-44.

Nathan, G. (2015). Innovation Process and Ethics in Technology: An approach to ethical (responsible) innovation governance, SPECIAL ISSUE: Responsible innovation in the private sector, Journal on Chain and Network Sciences, Wageningen Academic Publishers, Vol. 15(2): 119-134.

Tidd, J. & Bessant, J. (2009). Managing Innovation, England: John Wiley & Sons, Ltd.

Van den Hoven, M.J. (2013). Value sensitive design and responsible innovation. In: Owen, R., J. Bessant and M. Heintz (eds.) Responsible innovation. John Wiley and Sons Ltd., London, UK, pp. 75-83.

A NEW ENVIRONMENT FOR ENTREPRENEURSHIP AS A LEVER OF SUSTAINABLE BUSINESS DEVELOPMENT

Joaquim Ramos Silva
University of Lisbon, CSG/Socius, Lisbon School of Economics and Management, Portugal

Abstract: *When more than a century ago (Schumpeter, 1908), the entrepreneur emerged, in a context of increasing influence of neoclassical approaches, as a key player in the economic development process and the vehicle of innovation, the concept had a long and winding road to affirm itself on a theoretical ground. For a long period, has had happened before with precursors like Cantillon and Say during the classical age, the mainstream economic thinking of the first decades of the 20th century succeeded in putting aside this disturbing element to equilibrium explanations (Kirzner, 1973), and only in recent decades it gained enough scope by its own right, not necessarily through the best ways (for example, as it is something that can be easily learned or created ab nihilo). Anyway, the shift of emphasis towards a more assertive view of entrepreneurship as a pillar of economic theory is a very promising turn, insofar the economists' views became more realist and operational filling a gap that lasted to long time (Casson, 2003). As stated for example by Foss and Klein (2012), the theory of entrepreneurship is closely connected with the theory of firm what turns economists' concerns more oriented to the study "of the ordinary business of life". Therefore, in the search for solutions to economic problems, such as sustainable growth, productivity improvement, competitiveness, the introduction and spread of innovations, unemployment, among others, the entrepreneurship function also began to be compared with other instruments of the economists' toolkit, particularly at the macro level. The analysis of these different perceptions of the concept and its potential is our main objective insofar they are highly influential and must be closely followed.*

Regarding this new context for entrepreneurship, there are two perspectives that must be taken into account. On the one hand, the knowledge economy and the increasing key role of innovation in the modern economic process, where it became a routine according to Baumol (2002), reinforce more the relevance of the entrepreneur's contribution to the extent he has a higher capacity to use knowledge and to introduce into market activities in a competitive manner. On the other hand, many factors have contributed to the creation of a new economic rationale that emphasizes the contexts of uncertainty and risk (not only caused by the acceleration of change in the transformation of economic structures but also as a result of more recent events such as the financial crisis that erupted in 2007-2008 and its aftermath that weakened the belief that economists know well how to deal with these situations). All this led to a stronger valuation of the role of the entrepreneur, considered particularly apt to manage its businesses within such contexts. Indeed, it is in his behavior, in the sense of interacting with economic opportunities (arising from globalization or from the new technologies of information and communication and through other ways, novel or not), where lies the overtaking of the deadlock in which we are living. Hence, there are fundamental dimensions of the modern economy, clearly demanding more entrepreneurial commitment in the management of the economy, such as in synthesis: knowledge/innovation, and uncertainty/risk.

Despite the relevance of the historical background, the newly accepted role of the entrepreneur, and that of entrepreneurship in economic theory with its diverse linkages, must be put in the frame of reference of the 21st century. It must be recalled that in these circumstances, if we look at historical patterns, the state and its public policies are very much influential in economic life. This trend was perhaps slowed down in some respects in the last decades of the 20th century, but undoubtedly remains, either in advanced or in developing economies. Simultaneously, due to innovation and globalization there is a vast array of entrepreneurship initiatives as showed in the case of emergent economies, particularly when not depending on natural resources. So, beyond its recognition as a very important domain in economic theory, one point should be underlined: entrepreneurship must also have much more attention in the field of economic policy, at all levels of government, as a way of overcoming critical situations, and likely much less through traditional measures of public spending such as subsidies and others. However, it must be fairly recognized that much of the outcome of entrepreneurship is not easily discernible in the short term. From this point of view, it is relevant to compare, for example, with the new financial theories ("modern finance") that were promoted, particularly since the 1980s (Dowd and Hutchinson, 2010). Indeed, much of them showed their inability to bring sustained and sound solutions to economic and business problems, and created a bloated financial system that caused new and huge difficulties that were at the basis of the 2007-2008 crisis and the Great Recession that followed.

Now we will focus in more detail the new trends that characterize the entrepreneurial process. Rules and policy environment became often more friendly of entrepreneurial activities in large areas across the world. It became easier to create firms, but the burden of regulations and taxation remain important, and if they have been reduced in some domains, they rose in others, not always well founded. At a broader scale, the strong increase of foreign direct investment since the middle of the 1980s, with the correlated creation of global value chains, is a good sign of this process, particularly if we take into account that the entry of a firm in a new and foreign market, implies a higher degree of risk due to a lack of local knowledge. It is clear however that appropriate policies may improve the entrepreneur's capability in this field.

The emergence of entrepreneurship in the last decades significantly changed the theoretical landscape of economics and business. Although the process is far from being consolidated, we focused on some of its main aspects. Looking at the future, we hardly deny that entrepreneurship and entrepreneurs have a major role to play towards the improvement of economic structures, particularly when responsive to the true needs of the populations, and not only of particular groups. As referred to before there is a clear contrast with the relevance of what was called "modern finance". And the problem is not confined to the situation prior to 2008, as an author put it later as far as Quantitative Easing is concerned: "QE in some ways resembles the artificial seeding of clouds after a period of drought. Rain has fallen, catastrophe has been averted but much of the water lies in stagnant pools on the baked ground …" (Taylor, 2012). Thus, entrepreneurship has a great contribution to give in breaking out of these situations but often lacks the best environment (including at the level of public policies) to display its full capacity. All the issues that have been raised, show how important and necessary is to deepen the study of this subject in order to open routes for the affirmation of entrepreneurship in all its potential.

REFERENCES

Baumol, W.J. (2002). The Free Market Innovation Machine: Analyzing the growth miracle of capitalism. Princeton University Press. Princeton.

Casson, M. (2003). The Entrepreneur: An economic theory. 2nd Edition. Edward Elgar, Cheltenham/UK.

Dowd, K. and Hutchinson, M. (2010). Alchemists of Loss: How modern finance and government intervention crashed the financial system. John Wiley & Sons, Chichester.

Foss, N.J. and Klein, P.J. (2012). Organizing Entrepreneurial Judgment: A new approach to the firm. Cambridge University Press, Cambridge/UK.

Kirzner, I.M. (1973). Competition & Entrepreneurship. The University of Chicago Press. Chicago and London.

Schumpeter, J.A. (1908). Théorie de l'Évolution Économique. French version of 1935. Librairie Dalloz, Paris.

Taylor, M. (2012). The return of animal spirits would be good for all. Financial Times, September 21.

RSLINGO4PRIVACY: AN INTEGRATED APPROACH TO IMPROVE THE SPECIFICATION AND ANALYSIS OF PRIVACY POLICIES

Alberto Rodrigues Da Silva
University of Lisbon, INESC-ID, Instituto Superior Técnico, Portugal

Abstract: *Popular web and mobile applications attract and manage a huge number of users. They collect data from their users without ensuring traceability between privacy policies and application design decisions. A particular challenge for policy authors and application developers is the need to use a common language and companion tools that supports translating important privacy policy statements into actionable requirements. For example, European Union and United States employ privacy policies as "notices" to end users and, in the U.S., these policies are often the sole means to enforce accountability. Given the pressure to post privacy policies and the pressure to keep policies honest, companies must do more to align their policies and practices. In this respect, more should be accomplished by enabling developers with new tools to better specify their data needs while policy authors, who are typically legal professionals, can work with those specifications to create more accurate policies or to enforce those policies in the context of developer data needs.*

In general, a privacy policy is a technical document that states multiple privacy-related requirements that a system should satisfy. These requirements are usually defined as ad-hoc natural language (NL) statements. Natural language is an ideal medium to express these policies because it is flexible, universal, and humans are proficient at using NL to communicate. Moreover, natural language has minimal adoption resistance as a requirements documentation technique (Ferreira & Silva, 2012) (Ferreira & Silva, 2013). However, NL has intrinsic characteristics that become the root cause of quality problems, such as incorrectness, inconsistency or incompleteness (Ferreira & Silva, 2012) (Pohl, 2010).

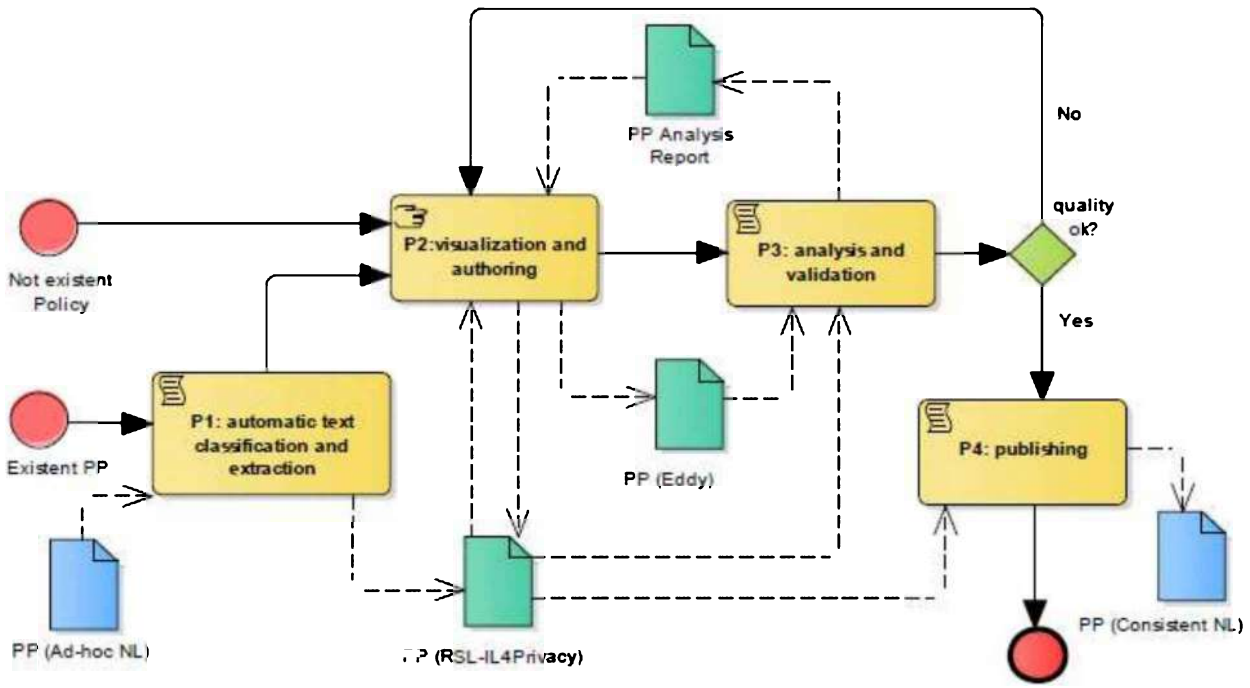


Figure 1: RSLingo4Privacy approach (defined with a BPMN business process diagram).

Recently we proposed the definition of a domain-specific language (DSL) for the specification of privacy-aware requirements, called RSL-IL4Privacy (Caramujo & Silva, 2015) . The RSL-IL4Privacy allows specify privacy policies by providing several constructs, such as statements, private data, recipients and

enforcement mechanisms, which are necessary to specify and document privacy-related requirements. The goal of the proposed approach is to use the RSL-IL4Privacy formalization as the necessary mechanism for the specification of policies while providing features for better analyzing and validating the corresponding privacy requirements.

RSLingo4Privacy is a multi-language approach that uses the following privacy-aware languages: RSL-IL4Privacy and Eddy. Figure 1 overviews RSLingo4Privacy approach as a top-level BPMN business process diagram. If a given (ad-hoc natural language) policy exists, the process P1 applies complex text classification and text extraction techniques to automatically produce the equivalent specification in RSL-IL4Privacy. In addition or otherwise, if that policy does not exist, the RSLingo4Privacy approach starts directly with process P2 to allow visualizing and authoring the policy in a rigorous and consistent way based on the RSL-IL4Privacy language. Process P3 takes as input both RSL-IL4Privacy and Eddy specifications, and provides analysis and validation features, producing, for example an analysis report with errors and warnings that can be taken into consideration during these authoring and validation processes. Finally, when the quality of the policy specified in RSL-IL4Privacy is appropriated, the process P4 is responsible for producing an improved version of the policy, specified again in natural language but in a more consistent and high-quality manner.

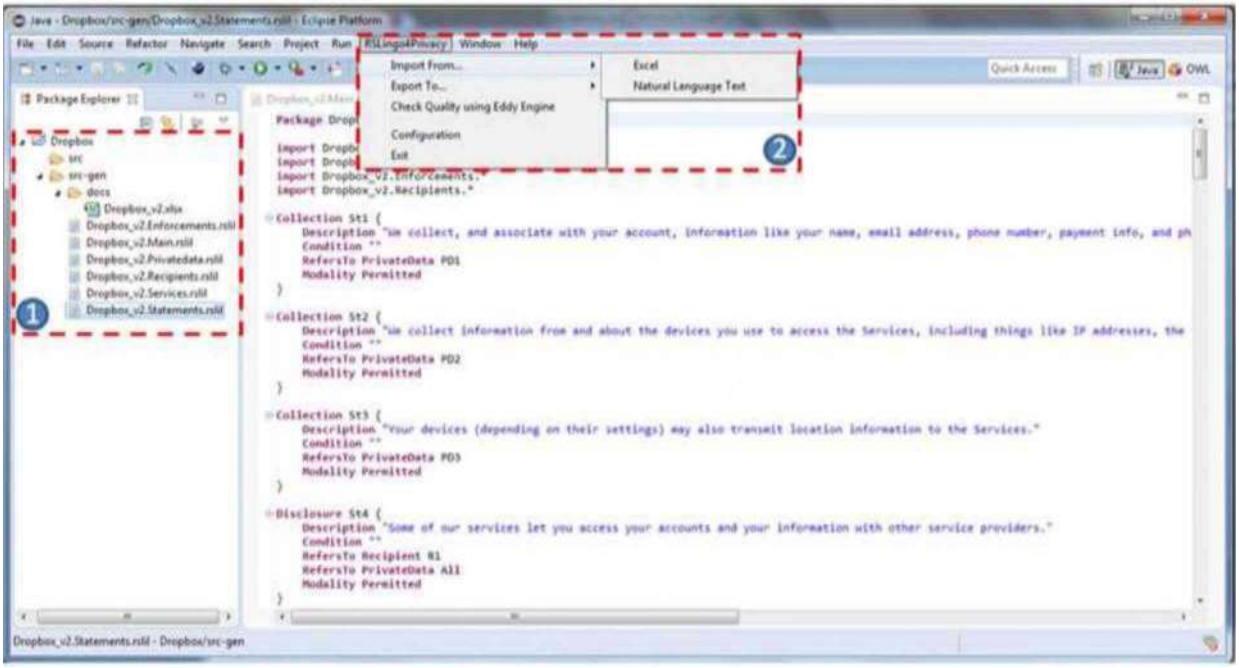


Figure 2. Structure of RSLingo project (1) and RSLingo4Privacy Main Menu bar (2).

This talk presents both the RSLingo4Privacy approach (Figure 1) and its companion tool, the RSLingo4Privacy-Studio,(Figure 2) which is particularly designed for better supporting the specification, analysis and documentation of privacy-aware requirements in the scope of privacy policies.

This work complements the current state-of-the-art by providing a versatile tool designed around the RSL-IL4Privacy domain specific language, with multiple representations while taking into account the importance of having requirements documented in a format as close to natural language as possible. This tool is built on top of the Eclipse IDE, and particularly leveraging and integrating technologies such as: Xtext, Xtend, Eclipse Modeling Framework (EMF), RapidMiner, Eddy engine and Apache POI library.

The explanation and validation with several case studies shows the potential of RSL-IL4Privacy as a rigorous language for expressing privacy requirements and, in addition, shows the relevance of the provided interoperability features. These features are classified by different classes of transformations, all of them founded on that common and intermediate format: RSL-IL4Privacy (defined with the respective Xtext grammar). First, T2M transformations intend to automatically classify NL statements and extract from them text snippets using text mining and text extraction algorithms. The implementation of such transformations is a complex task that involves the integration and tuning of tools like RapidMiner, and is still a working in progress research. Second, M2T transformations produce a consistent and easy-to-read version of a privacy policy. These versions can be produced in multiple formats, such as structured NL in Word, plain text or even HTML. Third, M2M transformations may include two variants: M2M transformations that support multiple representations of the RSL-IL4Privacy; for example, from plain text format (defined with Xtext) into tabular

format in Excel, and vice-versa; and finally, M2M transformations between RSL-IL4Privacy with other languages and formats, such as JSON or Eddy (which can be itself latter mapped in OWL or equivalent formats).

The major merit of the proposed approach is that it allows both technical and non-technical users to easily author and analyze policies using a language close to NL, but that is simultaneously readable by machines and so providing automatic validation at both syntactic and semantic levels. This fact permits RSL-IL4Privacy to act as an intermediate language and be supported by an environment that integrates multiple representations of a privacy policy addressing concerns of multiple stakeholders.

The concrete artifacts of the RSL-IL4Privacy representations for Dropbox, Facebook, LinkedIn and Twitter privacy policies, as well as the analysis of other case studies under the scope of RSLingo4Privacy are available and can be found on its GitHub repository (https://github.com/RSLingo/RSLingo4Privacy).

REFERENCES

Caramujo, J. & Silva, A.R. (2015). Analyzing Privacy Policies based on a Privacy-Aware Profile: the Facebook and LinkedIn case studies. *In Proc. of the 17th CBI conference*. IEEE, 1, 77-84.

Ferreira, D. & Silva, A.R. (2012). RSLingo: An Information Extraction Approach toward Formal Requirements Specifications. *In Proc. of the 2nd MoDRE workshop*. IEEE, 39-48.

Ferreira, D. & Silva, A.R. (2013). RSL-IL: An Interlingua for Formally Documenting Requirements. *In Proc. of the 3rd MoDRE workshop*. IEEE, 40-49.

Pohl, K. (2010). Requirements Engineering: Fundamentals, Principles, and Techniques. Springer.

Silva, A.R. et al. (2016). Improving the Specification and Analysis of Privacy Policies: The RSLingo4Privacy Approach. *In Proc. of the 8th ICEIS conference*. SCITEPRESS.

BUSINESS ANALYTICS AND OPTIMIZATION 1

MEASURING SOCIAL PREFERENCES USING EXPERIMENTAL GAMES: LITERATURE REVIEW 2
Kuzmanović Marija, Blažić Tijana

AHP GROUP DECISION MAKING: EXAMPLE OF SELECTING EVALUATORS FOR EVALUATION OF PERFORMANCE OF MILITARY MOTOR VEHICLES DRIVERS 10
Lukovac Vesko, Pamučar Dragan, Gigović Ljubomir

MULTICRITERIA DECISION MAKING - PRACTICAL EXAMPLE OF AHP BASED APPROACH FOR SUPPLIER SELECTION 18
Mihailovic Jovana

EFFICIENCY EVALUATION OF ABA LEAGUE TEAMS FOR THE SEASON 2012-13 THROUGH DMU CLUSTERING AND DEA 26
Mitrović Maja

APPLICATION OF GENETIC ALGORITHM IN AUTOMATED TRADING 34
Jovanović Pavle, Rakićević Aleksandar, Petrović Bratislav

ON A PARAMETRIC APPROACH TO IMPROVE THE SOLUTION TO A FUZZY BI-CRITERIA TRANSPORTATION PROBLEM 41
Stanojević Bogdana, Stanojević Milan

OPTIMAL ADJUSTMENTS OF ORDER QUANTITIES DUE TO PACKAGING AND TRUCK CONSTRAINTS 48
Đorđević Aleksa, Belić Ana, Makajic-Nikolic Dragana

OPTIMAL HETEROGENEOUS STAFF SCHEDULING IN CASE OF PLANNING A SPECIAL EVENT 54
Hadžiahmetović Maja, Marinović Minja

AGENT-BASED MODELS: A REVIEW OF APPLICATIONS 61
Zornic Nikola, Markovic Aleksandar

THE INFLUENCE OF EDUCATIONAL DEVELOPMENT INDICATORS ON GRADUATES' EMPLOYMENT RATES 68
Bjelaković Ana, Dobrota Marina

IMPACT OF LARGE EXPORTERS' OWNERSHIP STRUCTURE ON THE GROWTH OF EXPORT IN SERBIA 76
Jeremić Zoran

THE ALTERATION OF U21 RANKING METHODOLOGY: FROM EXPERT-DRIVEN TO DATA-DRIVEN WEIGHTING SCHEME 83
Maričić Milica, Bulajić Milica, Dobrota Marina

SELECTING AN APPROPRIATE METHOD FOR MISSING DATA IMPUTATION: A CASE OF COUNTRIES RANKING 91
Rakićević Jovana, Savić Gordana, Bulajić Milica

THE CONJOINT ANALYSIS OF PARENTS' PREFERENCES TOWARDS CHILDREN'S PHYSICAL ACTIVITIES 100
Šormaz Jelena, Kuzmanović Marija, Jeremić Veljko

BUSINESS ANALYTICS AND OPTIMIZATION

MEASURING SOCIAL PREFERENCES USING EXPERIMENTAL GAMES: LITERATURE REVIEW

Marija Kuzmanović*[1], Tijana Blažić[1]
[1]University of Belgrade, Faculty of Organizational Sciences
*Corresponding author, e-mail: marija.kuzmanovic@fon.bg.ac.rs

Abstract: *In the last few decades, there is an increased interest in social preferences. They point to the fact that individuals are not rational all the time, although it may be desirable. For measuring the social preferences a variety of experimental games can be used. This paper points to the possibility of measuring the social preferences using the experimental games and focuses on two experimental games: ultimatum and dictator game. The results of experiments which use the ultimatum game, have shown that social preferences influence on decision making, as well as factors such as cultural norms, gender have effect to the social preferences. As far as the dictator game, the results indicates on the fact that factors (altruism, social pressure, empathy and others) have influence on the giving in this game.*

Keywords*: social preferences, behavioral game theory, experimental games, ultimatum game, dictator game*

1. INTRODUCTION

One of the standard assumptions in economics is that individuals are motivated by only their material self – interest (Baran et al, 2010). Although Adam Smith in his *Theory of Moral Sentiments* (1759) recognized the possibility that some individuals exhibit other types of interests, it is only in the last few decades have seen a strong course of interest in what are now widely known in economics as "social preferences". Social preferences refer to the phenomena that people seem to care about certain ~~-s~~ocial" goals, such as well-beings of other individuals, or a ~~-f~~air" allocation among members in society, in addition to their own material benefits (Li, 2008).

In their seminal paper, Fehr and Schmidt (1999) suggested that while many people might be motivated only by pure self-interest, this need not be the case for all people. They theorized that some people may be basically motivated by fairness concerns, reciprocity (reward kindness and punish unkindness) and even pure (unmotivated) altruism (Baran et al, 2010) but also they sometimes act in the entire group's interest, even if it hurts some individuals in the group (Li, 2008).

While the study of social behaviors has a long tradition in economics, psychology and sociology, recently, the term social preferences has come to be associated with a more specific program of research originated mainly in experimental and behavioral economics (Galizzi, & Navarro Martinez, 2015).

A considerable body of experiments has examined the effects of various demographic variables on the social preferences (see Wilkinson, & Klaes, 2012). The variable most frequently studied are gender (Heinz et al, 2011), age (Gummeru et al, 2010; Wittig et al, 2013), academic major (Kahneman et al, 1986; Kuzmanovic et al, 2012), culture (Henrich et al, 2005), social distance (Charness & Gneezy, 2008) and religious identity (Brañas-Garza et al, 2014; Gomes & McCullough, 2015).

Other factors whose effects on social preferences experimentally examined are: anonymity (Dufwenberg, & Muren, 2006; List, 2007; Bardsley, 2008; Franzen & Pointer, 2012; Winking & Mizer, 2013); the context and framing (Branas-Garza, 2007; Stoop, 2014) the size of the stakes (Carpenter et al., 2005; List and Cherry, 2008); the subject pool (Cleave et al, 2013; Exadaktylos et al, 2013; Stoop, 2014). One of the recent studies (Arfer et al, 2015) suggests that people may behave prosocially not only because they value the welfare of others, but also to protect their own reputation.

In this paper will be shown some of the experimental games which can be used for measuring the social preferences. It will also be shown an overview of the results of experiments in which have been used the experimental games.

2. SOCIAL PREFERENCE MODELS

There are essentially two types of social preferences: distributive and reciprocal. Distributive preferences assume that individuals have preferences over final payoff allocations (Li, 2008), while reciprocal preferences mean that individuals desire to reward or punish others beyond mere consequences. Accordingly, the existing literature on social preferences distinguishes three main classes of models (Schmidt, 2011): (1) outcome-based social preferences, (2) intention-based social preferences, and (3) type dependent social preferences.

In models of *outcome-based social preferences,* the utility of each player depends directly on the material payoff of other players in his reference group. For example, the theories of unconditional altruism (Andreoni & Miller, 2002) assume that the utility of a player not only depends on his own material payoff but it is also monotonically increasing in the monetary payoff of other players. Charness and Rabin (2002) show that subjects are more concerned with increasing social welfare (sacrificing to increase the payoffs for all recipients, especially low-payoff recipients) than with reducing differences in payoffs. The Fehr-Schmidt model is consistent with observed behavior in many experimental games but it assumes that people care only about outcomes and not about intentions.

Models of *intention-based social preferences* try to capture intention effects and incorporate the idea that players benefit from reciprocating (or punishing) acts to which they attribute good (or bad) intentions (Netzer, & Schmutzler, 2014). In these models, preferences are defined not only over outcomes but also over beliefs about why a player has chosen certain actions. Namely, players reward kind and punish unkind intentions. Rabin (1993) assumes that the social preferences are driven by players' kindness towards each other: if a player believes the opponent's action is motivated by kindness toward him, then he prefers to react kindly; and vice versa. According Falk et al. (2003) players are punishing much more in case that can be inferred that exist a greedy intention or personality. The *intention-based* model successfully accounts for retaliatory and altruistic behavior (Li, 2008) and requires the use of psychological game theory (Dufwenberg and Kirchsteiger 2004, Falk and Fischbacher 2006).

Finally, in type-based models, the level of the payoff to another player depends on one's own (distributional) basic attitude as well as the perceived basic attitude of the other player (Kerschbamer, 2015). In other words, in type-based social preferences models (Rotemberg, 2008), a player behaves kindly to a ~~"g~~good" person and hostile towards a ~~"b~~ad" person. For instance, in Levine (1998) people are altruistic (or spiteful) to various degrees and – given their own basic altruism – they place more positive (negative) weight on the money received by an opponent who is believed to be more altruistic (spiteful). Andreoni and Bernheim (2009) have a similar model in which others' other-regarding concerns are evaluated in the terms of inequality aversion (and not in the terms of altruism).

3. BEHAVIORAL GAME THEORY

Game theory is the study of mathematical models of conflict and cooperation between intelligent rational decision-makers (Myerson, 1991). It is multiplayer decision theory where the choices of each player affect the payoffs to other players, and the players take this into account in their choice behavior (Gintis, 2009). Game theory provides the conceptual and procedural tools for studying the social interaction, including the characteristics of the players, the rules of the game, the informational structure, and the payoffs associated with particular strategic interactions.

Game theory is designed to be flexible enough to be used at many levels of detail in a broad range of sciences. Players may be people, groups, companies or nations. Strategies may be either an action taken by a player at some point during the play of a game or a complete plan of actions i.e. algorithm for playing the game. Outcomes can be anything players value – money, prestige, corporate profits or captured territory (Camerer, & Fehr, 2002).

The most central concept in game theory is a solution concept of non-cooperative games, known as Nash equilibrium. A set of strategies (one for each player) form an equilibrium if each player is choosing the strategy which is a best response to the other players' strategies. A common assumption underlies an equilibrium is that players act rationally. However, in practice (in the real world situations), human behavior often deviates from this model.

Behavioral game theory is about what players *actually* do (Camerer, 2003). It expands analytical theory by adding emotion, mistakes, limited foresight, doubts about how smart others are. Actually, behavioral game theory analyzes interactive strategic decisions and behavior using the methods of game theory, experimental economics, and experimental psychology. It attempts to explain decision making using experimental data,

and allows for rational and irrational decisions because both are examined using real-life experiments. Specifically, behavioral game theory attempts to explain factors that influence real world decisions (Colman, 2003).

Several experimental games, particularly the ultimatum game, dictator game, trust game, gift exchange game, and public goods game, are widely used to measure the impact and magnitude of the social preferences. In this paper will be shown two types of experimental games, the ultimatum and dictator game.

3.1. Ultimatum game

Using results of experiments with Ultimatum game, some studies confirmed that the social preferences certainly influence the decision-making process as well as the interactions that people have with each other (Ciampaglia et al, 2014). Also, some authors used the Ultimatum game to examine whether social norms and beliefs affect the distribution of money (Camerer & Fehr, 2002). It is certainly of great importance because social norms determine the type of social preferences, specifically directed individual towards pro-social type of social preferences. If it turns out the fact that the individuals affected by social norms, individuals will be less selfish or completely unselfless during the resource allocation (Azar et al, 2015).

Ultimatum games represent a form of take-it-or-leave-it bargaining (Güth et al, 1982). The first player (proposer) receives a sum of money (S) proposes how to divide the sum between the proposer and the other player. The second player (responder) chooses to either accept offer x, or reject it, in which case neither player receives any money. If the Responder accepts he earns x and the Proposer earns $S - x$. The game is typically played only once (see Figure 1).

In theory, rational (self-interested) responders will accept any positive offer, and proposers who anticipate this should offer the smallest possible positive amount because for the responder something is better than nothing at all. The ultimatum game measures whether responders will negatively reciprocate, sacrificing their own money to punish a proposer who has been unfair.

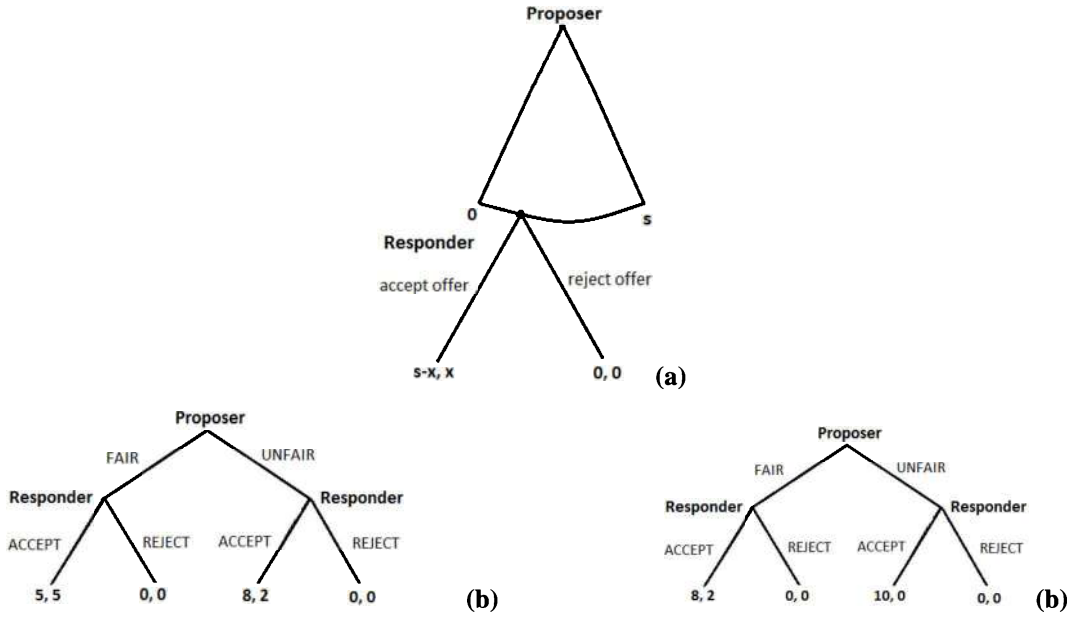


Figure 1: (a) Classic ultimatum game, (b) mini ultimatum games

The experimental results are in stark contrast to the rational solution. On average, proposers offer about 40% of the initial amount (S) to the responder, while Responders reject offers less than 20% of S about half the time (Camerer, 2003). It has also been found that delaying the responder's decision makes people accept "unfair" offers more often (Oechssler et al, 2015).

As Falk and Fischbacher (2006) pointed out, two types of fairness considerations are at work when playing the ultimatum game: outcome-based fairness, in which one compares one‘s own gains and losses relative to those of others, and intention-based fairness, in which one also takes into account the motives lying behind the outcomes (Wittig et al, 2013). Falk et al. (2003) consider a mini-ultimatum game which directly addresses these two possibilities. In this form of game, the proposer is restricted to choose between two different

allocations. In one treatment he can choose between (8,2) and (5,5), in another treatment he can choose between (8,2) and (10,0). In the first treatment the choice of (8,2) may be considered greedy, because he could have offered the equal split (5,5). In the second treatment the choice of (8,2) may be considered generous, because the only alternative would have been (10,0). (see Fugure 1, Schmidt, 2011).

Wittig et al, 2013 used mini-ultimatum game to determine the nature of fairness sensitivity at a period before formal schooling begins (five years olds). They found that preschool children seem to understand „fair = equal" in this task, but not much more, and they are not yet skillful at anticipating what others will find fair beyond 50/50 splits.

The responders took into account the options the proposer had available when he proposed a particular division of resources, including ones that were not equal (Falk et al., 2003). On the other hand, proposers take responder's perspective into account in that they tend to choose the fairest possible alternative and never make offers of zero. For example, when the proposer chooses between offering 20% or 75%, an offer of 20% is rejected 33% of the time. On the other hand, when the proposer's choice set is changed to (20%, 87.5%), the rejection rate for an offer of 20% drops to 16% (Charness and Rabin 2002; Li, 2008).

Some authors suggest that making an fair offer is indeed a rational behavior on the part of proposers because they should take responders' perspective into account (assuming responders are not rational in the standard economic sense) and make an "optimal" offers, that is, those that have a high probability of being accepted while still giving a high payoff to the proposer (Wittig et al, 2013). Harbaugh et al. (2007) suggested that in the practice, people make "optimal" offers, that is, those that have a high probability of being accepted while still giving a high payoff to the proposer.

Many studies have shown that both the proposer's and responder's behavior relies on what they consider to be a fair distribution, sometimes is influenced by general cultural norms (Henrich et al., 2005). The first detailed study in 1991 by Roth et al. examined subjects in four countries: the USA, Japan, Israel and Yugoslavia. They find out that the highest offers are made in the USA and Yugoslavia, and the lowest offers are made in Israel, with Japan in the middle. The main finding was that offers were on average about 10% in Japan and Israel. Interestingly, countries with lower offers did not have higher rates of disagreement. Instead, somewhat lower offers were accepted in countries where low offers were made. Henrich (2000) reports differences between 18 - 30 olds Machiguenga men of the Peruvian Amazon and students at UCLA.

Wilkinson and Klaes (2012) emphasize that although there are a number of significant differences between the genders in terms of fairness and social preferences, there is no simple pattern. Eckel and Grossman, (2001) experimentally demonstrated that in ultimatum game both sexes make similar offers, while woman reject less often. In addition, some authors are using the Ultimatum game pointed to the preferences of people towards the so-called "round" amounts of money, namely that people are choosing a specific amount, for example, half, quarter, and so on (Azar et al, 2015).

3.2. Dictator Game

The dictator game is similar to the ultimatum game. In this game, the first player, (dictator), determines how to split an endowment (such as a cash prize) between himself and the second player (recipient). The recipient simply receives the remainder of the endowment left by the dictator and his role is entirely passive and has no input into the outcome of the game.

Since the dictator's outcome depends only on his own actions, Dictator game is considered as degenerate game and has been used to test the "*Homo economicus*" model of individual behavior. Model "*Homo economicus*" means that individual is concerned with their own economic well being, and dictators would allocate the entire good to themselves and give nothing to the recipient. However, experimental results offer evidence against the rationally self-interested individual concept (Bardsley, 2008).

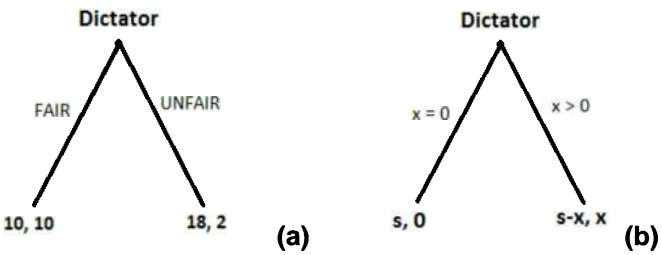


Figure 2: a) Dictator game (Kahneman et al. 1986), b) general form of the Dictator game

The first dictator game experiment was conducted by Kahneman et al, (1986). Authors gave subjects a choice either to split of $20 ($10 each) with another student or an uneven split ($18, $2), favoring themselves. Majority of the students (75%) chooses the equal split. Forsythe et al. (1994) later carried out the dictator game with real stakes and obtained similar results. They find that 70% of the dictators actually do not choose to leave entire endowment for themselves, leaving the recipient with on average 24% of the total amount. Similar patterns have been found in many different dictator game settings. As Camerer (2003) points out, a plenty of subsequent dictator experimental studies replicate these results, finding that usually more than 60 percent of subjects give away a positive amount of money, with the mean transfer roughly 20 percent of the endowment. This has induced numerous researchers to investigate the motivation for such behavior.

The most common explanations for giving in experimental dictator game are altruism and social pressure (Akerlof & Kranton, 2000). Eckel and Grossman (1996) proposed a variant of the dictator game in which a subject decides how to allocate a sum of money between herself and a charity. Moreover, Fong (2007) has shown that an empathy is a more important motivation for dictator game giving when recipients are perceived to be in great need. Additional experiments have shown that subjects maintain a high degree of consistency across multiple versions of the dictator game in which the cost of giving varies (Andreoni, & Miller, 2002).

Most dictator game studies involve only an anonymous recipient. In a few studies, the participants are informed about one or two characteristics of the recipients like the gender (Dufwenberg and Muren 2006) or the name of the organization (DellaVigna et al, 2012). Some studies suggest that Dictator giving tends to increase when weakening anonymity across subjects (Burnham, 2003; Engel, 2011) or when adding an additional observer (Cason and Mui, 1997). However, Bolton et. al (1998) find no significant experimenter anonymity effect.

It has been also argued that giving in dictator games might arise from a desire of subjects to appear acting in a socially appropriate way because their individual behavior is observed by others (Hoffman et al. 1994). Since dictators‘ behavior might also be influenced by expectations about the experimenter‘s judgement, Frequency of positive offers and average donations drop significantly relative to Forsythe et al. (1994). On the other hand, Koch & Normann (2008) suggest that when strategic considerations are eliminated it does not matter to an individual how his or her actions are perceived by others.

Razzaque (2009) experimentally demonstrated that receiver's gender is an important factor of influence on the decision on giving. Some researcher suggests that women are more generous than men (Aguiar et al, 2009) even when recipients have to expert effort to earn rewards as opposed to receiving them as gifts (Heinz et al, 2011). In modified versions of the dictator game, children also tend to allocate some of a resource to a recipient and most five-year-olds share at least half of their goods (Gummerum et al, 2010).

Shariff and Norenzayan (2007) investigated the effect of religious identity on generosity in a dictator game. They found a significant positive effect of religious identity on generosity; the religiously primed participants allocated more money to anonymous strangers than did participants who were not primed. Ahmed and Salas (2011) provide more evidence for religious identity being positively related to generosity in a dictator game.
Brañas-Garza et al, (2014) also explored the relationship between several personal religion-related variables and social behavior, using dictator and ultimatum games. They found that individuals with ~~-n~~o religion” made decisions closer to rational selfish behavior compared to those who affiliate with a ~~-s~~tandard” religious denomination. However, some studies suggest that the effect of religious priming on generosity in the dictator game may be more limited than previously thought (Gomes & McCullough, 2015).

Forsythe et al. (1994) were the first to compare offers in the ultimatum game to offers in the dictator game. They find out that offers in the dictator game are considerably less generous. A significant fraction of dictators give nothing. This shows that many proposers are generous only for strategic reasons in the ultimatum game.

4. CONCLUSION

Economics argues that each individual is rational, or whether it is really so. Even when it is desirable to be rational does not mean that this is actually happening, and that all people are motivated by self-interests (Fehr and Schmidt, 1999). The experimental results offer evidence against the rationally self-interested individual concept. In recent decades, it appears increased interest in social preferences. The reason is that

they help to understand the behavior of individuals and to discover the factors of influence on the decision-making process.

The review literature suggests ways of measuring the social preferences using the experimental games. As reported throughout the current review, using the ultimatum game, has been discovered that social preferences influence on decision-making. It have been also discovered factors which have influence such as social norms, beliefs (Camerer & Fehr, 2002), cultural norms and gender. It has also been found that delaying the responder's decision makes people accept "unfair" offers more often. According to some authors, people are choosing a specific amount, so-called "round" amounts of money.

Observing the review, using the dictator game, as results in experiments appear different factors for giving: altruism, social pressure, gender, religious identity, and empathy. It has been also argued that giving might arise from a desire of subjects to appear acting in a socially appropriate way because their individual behavior is observed by others.

This paper presents the results of experiments where the experimental games are used for measuring the social preferences. However, researchers should not be limited to the measurement of social preferences using the experimental games only. The direction of future experiments, in this area, can relate to new methods of measurement of the social preferences. Also, some subsequent experiments may relate to new factors and examine their impact on social preferences.

REFERENCES

Aguiar, F., Brañas-Garza, P., Cobo-Reyes, R., Jimenez, N., & Miller, L.M. (2009). Are women expected to be more generous?. *Experimental Economics*, *12*(1), 93-98.

Ahmed, A., & Salas, O. (2011). Implicit influences of Christian religious representations on dictator and prisoner's dilemma game decisions. *The Journal of Socio-Economics , 40* (3), 242-246.

Akerlof, G.A., & Kranton, R.E. (2000). Economics and identity. *Quarterly journal of Economics*, 715-753.

Andreoni, J., & Bernheim, B.D. (2009). Social image and the 50–50 norm: A theoretical and experimental analysis of audience effects. *Econometrica*, *77*(5), 1607-1636.

Andreoni, J., & Miller, J. (2002). Giving according to GARP: An experimental test of the consistency of preferences for altruism. *Econometrica*, *70*(2), 737-753.

Arfer, K.B., Bixter, M.T., & Luhmann, C.C. (2015). Reputational concerns, not altruism, motivate restraint when gambling with other people's money. *Frontiers in psychology*, *6*.

Azar, O.H., Lahav, Y., & Voslinsky, A. (2015). Beliefs and social behavior in a multi-period ultimatum game. *Frontiers in behavioral neuroscience*, *9*.

Baran, Carpenter N.M., Sapienza, P., & Zingales, L. (2010). *Can we infer social preferences from the lab? Evidence from the trust game* (No. w15654). National Bureau of Economic Research.

Bardsley, N. (2008). Dictator Game giving: Altruism or artefact? Experimental Economics, 11(2), 122-133.

Brañas-Garza, P. (2007). Promoting helping behavior with framing in dictator games. *Journal of Economic Psychology*, *28*(4), 477-486.

Brañas-Garza, P., Espín, A.M., & Neuman, S. (2014). Religious pro-sociality? Experimental evidence from a sample of 766 Spaniards. PloS one, 9(8), e104685.

Brañas-Garza, P., Espín, A.M., Exadaktylos, F., & Herrmann, B. (2014). Fair and unfair punishers coexist in the Ultimatum Game. *Scientific reports*, *4*.

Burnham, T., 2003. Engineering altruism: a theoretical and experimental investigation of anonymity and gift-giving. Journal of Economic Behavior and Organization 50, 1–13.

Bolton, G. E., R. Zwick, and E. Katok (1998): –Dictator game giving: Rules of fairness versus acts of kindness," *International Journal of Game Theory*, 27, 269–299.

Camerer, C. (2003). *Behavioral game theory: Experiments in strategic interaction*. Princeton University Press.

Camerer, C.F., & Fehr, E. (2002). Measuring social norms and preferences using experimental games: A guide for social scientists.

Carpenter, J., Verhoogen, E., & Burks, S. (2005). The effect of stakes in distribution experiments. *Economics Letters*, *86*(3), 393-398.

Cason, T. N., & Mui, V. L. (1997). A Laboratory Study of Group Polarisation in the Team Dictator Game. *The Economic Journal*, *107*(444), 1465-1483.

Charness, G., & Gneezy, U. (2008). What's in a name? Anonymity and social distance in dictator and ultimatum games. *Journal of Economic Behavior & Organization*, *68*(1), 29-35.

Charness, G., & Rabin, M. (2002). Understanding social preferences with simple tests. *Quarterly journal of Economics*, 817-869.

Ciampaglia, G.L., Lozano, S., & Helbing, D. (2014). Power and fairness in a generalized ultimatum game. *PloS one*, *9*(6), e99039.
Cleave, B.L., Nikiforakis, N., & Slonim, R. (2013). Is there selection bias in laboratory experiments? The case of social and risk preferences. *Experimental Economics*, *16*(3), 372-382.
Colman, A.M. (2003). Cooperation, psychological game theory, and limitations of rationality in social interaction. *Behavioral and brain sciences*, *26*(02), 139-153.
DellaVigna, S., List, J. A., & Malmendier, U. (2009). *Testing for altruism and social pressure in charitable giving* (No. w15629). National Bureau of Economic Research.
Dufwenberg, M., & Kirchsteiger, G. (2004). A theory of sequential reciprocity. *Games and economic behavior*, *47*(2), 268-298.
Dufwenberg, M., & Muren, A. (2006). Generosity, anonymity, gender. *Journal of Economic Behavior & Organization*, *61*(1), 42-49.
Eckel, C.C., & Grossman, P.J. (2001). Chivalry and solidarity in ultimatum games. *Economic Inquiry*, *39*(2), 171-188.
Eckel, C.C., & Grossman, P.J. (1996). Altruism in anonymous dictator games. *Games and economic behavior*, *16*, 181.
Engel, C. (2011). Dictator games: a meta study. Experimental Economics, 14(4), 583-610, doi:10.1007/s10683-011-9283-7.
Exadaktylos, F., Espín, A.M., & Branas-Garza, P. (2013). Experimental subjects are not different. *Scientific reports*, *3*.
Falk, A., & Fischbacher, U. (2006). A theory of reciprocity. *Games and economic behavior*, *54*(2), 293-315.
Falk, A., Fehr, E., & Fischbacher, U. (2003). On the nature of fair behavior. *Economic Inquiry*, *41*(1), 20-26.
Fehr, E., & Schmidt, K.M. (1999). A theory of fairness, competition, and cooperation. *Quarterly journal of Economics*, 817-868.
Fong, C.M. (2007). Evidence from an experiment on charity to welfare recipients: Reciprocity, altruism and the empathic responsiveness hypothesis. *The Economic Journal*, *117*(522), 1008-1024.
Forsythe, R., Horowitz, J.L., Savin, N.E., and Sefton, M. (1994). Fairness in Simple Bargaining Experiments. *Games and Economic Behavior*, 6, 347-369.
Franzen, A., and Pointner, S. (2012). Anonymity in the dictator game revisited. *Journal of Economic Behavior and Organization*, 81(1), 74-81.
Galizzi, M.M., & Navarro Martinez, D. (2015). On the external validity of social-preference games: A systematic lab-field study.
Gintis, H. (2009). The bounds of reason: Game theory and the unification of the behavioral sciences. Princeton University Press.
Gomes, C.M., & McCullough, M.E. (2015). The effects of implicit religious primes on dictator game allocations: A preregistered replication experiment. *Journal of Experimental Psychology: General*, 144(6).
Gummerum, M., Hanoch, Y., Keller, M., Parsons, K., & Hummel, A. (2010). Preschoolers' allocations in the dictator game: The role of moral emotions. *Journal of Economic Psychology*, *31*(1), 25-34.
Güth, W., Schmittberger, R., & Schwarze, B. (1982). An experimental analysis of ultimatum bargaining. *Journal of economic behavior & organization*, *3*(4), 367-388.
Harbaugh, W.T., Krause, K., & Vesterlund, L. (2007). Learning to bargain. *Journal of Economic Psychology*, 28(1), 127-142.
Heinz, M., Juranek, S., & Rau, H.A. (2011). Do Women Behave More Reciprocally than Men. *Gender Differences in Real Effort Dictator Games*, 105-110.
Henrich, J. (2000). Does culture matter in economic behavior? Ultimatum game bargaining among the Machiguenga of the Peruvian Amazon. *The American Economic Review*, *90*(4), 973-979.
Henrich, J., Boyd, R., Bowles, S., Camerer, C., Fehr, E., Gintis, H. (2005). „Economic man" in cross-cultural perspective: Behavioral experiments in 15 small-scale societies. *Behavioral and Brain Sciences*, 28, 795–855.
Hoffman, E., McCabe, K., Shachat, K., & Smith, V. (1994). Preferences, property rights, and anonymity in bargaining games. *Games and Economic Behavior*, *7*(3), 346-380.
Kahneman, D., Knetsch, J.L., & Thaler, R.H. (1986). Fairness and the assumptions of economics. *Journal of business*, S285-S300.
Kerschbamer, R. (2015). The geometry of distributional preferences and a non-parametric identification approach: The Equality Equivalence Test. *European economic review*, *76*, 85-103.
Koch, A.K., & Normann, H.T. (2008). Giving in dictator games: Regard for others or regard by others?. *Southern Economic Journal*, 223-231.
Kuzmanovic, M., Djurovic, M., & Martic, M. (2012). Factors affecting cooperation in social dilemmas: Experimental evidence from one-shot prisoner's dilemma. *Technics Technologies Education Management-TTEM*, *7*(1), 384-394.
Levine, D. K. (1998). Modeling altruism and spitefulness in experiments. *Review of economic dynamics*, *1*(3), 593-622.

Li, J. (2008). The power of conventions: A theory of social preferences. *Journal of Economic Behavior & Organization*, *65*(3), 489-505.
List, J.A. (2007). On the interpretation of giving in dictator games. *Journal of Political Economy*, *115*(3), 482-493.
List, J.A., and Cherry T.L. (2008), Examining the role of fairness in high stakes allocation decisions. *Journal of Economic Behavior & Organization* 65(1), 1-8.
Myerson, R. (1991). Game Theory: Analysis of ConflictHarvard Univ. Press, Cambridge.
Netzer, N., & Schmutzler, A. (2014). EXPLAINING GIFT- EXCHANGE—THE LIMITS OF GOOD INTENTIONS. *Journal of the European Economic Association*, *12*(6), 1586-1616.
Oechssler, J., Roider, A., & Schmitz, P.W. (2015). Cooling-Off in Negotiations-Does It Work?. *Journal of Institutional and Theoretical Economics JITE **171** (4): 565–588.*
Rabin, M. (1993). Incorporating fairness into game theory and economics. *The American economic review*, 1281-1302.
Razzaque, S. (2009). The ultimatum game and gender effect: Experimental evidence from pakistan. *The Pakistan Development Review*, 23-46.
Rotemberg, J.J. (2008). Minimally acceptable altruism and the ultimatum game. *Journal of Economic Behavior & Organization*, *66*(3), 457-476.
Roth, A.E., Prasnikar, V., Okuno-Fujiwara, M., & Zamir, S. (1991). Bargaining and market behavior in Jerusalem, Ljubljana, Pittsburgh, and Tokyo: An experimental study. *The American Economic Review*, 1068-1095.
Schmidt, K.M. (2011). Social preferences and competition. *Journal of Money, credit and Banking*, *43*(s1), 207-231.
Shariff, A.F., & Norenzayan, A. (2007). God is watching you priming God concepts increases prosocial behavior in an anonymous economic game. *Psychological science*, *18*(9), 803-809.
Stoop, J. (2014). From the lab to the field: envelopes, dictators and manners. *Experimental Economics*, *17*(2), 304-313.
Wilkinson, N., & Klaes, M. (2012). *An introduction to behavioral economics*. Palgrave Macmillan.
Winking, J., & Mizer, N. (2013). Natural-field dictator game shows no altruistic giving. *Evolution and Human Behavior*, *34*(4), 288-293.
Wittig, M., Jensen, K., & Tomasello, M. (2013). Five-year-olds understand fair as equal in a mini-ultimatum game. *Journal of experimental child psychology*, *116*(2), 324-337.

AHP GROUP DECISION MAKING: EXAMPLE OF SELECTING EVALUATORS FOR EVALUATION OF PERFORMANCE OF MILITARY MOTOR VEHICLES DRIVERS

Vesko Lukovac*[1], Dragan Pamučar[1], Ljubomir Gigović[1]
[1] University of Defense, Military Academy
*Corresponding author, e-mail: lukovacvesko@yahoo.com

Abstract: *This paper deals with group decision making based on complete information. Known method for decision support, Analytical Hierarchy Process (AHP), was used individually by twenty participants in the task: selecting evaluators for evaluation of performance of military motor vehicles drivers. The deciding group consisted of twenty officers of the traffic department of the Army of Serbia (VS). Synthesis of individual evaluations was carried out afterwards using geometric averaging method. Additional analysis of the individual performance of decision makers was performed using the conformity index and Spirman's rank correlation coefficient.*

Keywords: AHP, group decision-making, evaluators, drivers, military vehicles

1. INTRODUCTION

The final score of evaluating the performance of driver of military motor vehicles (m/v) in VS according to the current approach is the result of the evaluation of a person – his direct superior. However, from the standpoint of successful human resource management, one of the measures recommended for the reduction of errors of evaluators in the process of evaluating the performance of employees is the inclusion of several evaluators in the evaluation process! Accordingly, there is the question: To whom the role of evaluators in the process of evaluating the performance of drivers of military m/v would be given? For the selection of persons who may be given the role of evaluators in the process of evaluating the performance of employees there are several options at disposal. Evaluator, in principle, can be any person who knows and follows the work process. Five primary sources that are recommended for the selection of persons who may be involved in the process of evaluation of the performance of employees (Noe, Hollenbeck, Gerhart & Wright, 2006):

1) managers, and direct supervisors;
2) co-workers;
3) subordinates;
4) employees (self-evaluation);
5) customers-consumers;

Starting from one of the five primary sources, which are recommended for the selection of evaluators in the process of evaluating the performance of employees, the final score of evaluating the performance of drivers of military m/v may be the result of the evaluation by direct superior (superior officer), by those who are on the same organizational level (co-worker), by personal evaluation (self-evaluation), as well as by clients (service user). Performance evaluation of drivers of military m/v can not only be the result of the evaluation by a direct subordinate, considering that drivers of military m/v represent the lowest - executive level in the organizational structure of the transportation service of VS. On the other hand again, based on the assumptions evaluation of 360 degrees, this process could include dispatchers. Therefore, pursuant to the recommendation for inclusion of more evaluators in the process of evaluating the performance of employees, the final score of evaluating the performance of drivers of military m/v may be the result of evaluation: direct his supervisor, dispatchers, colleagues, service users and their own evaluation.

However, the question of whether final score of evaluating the performance of drivers of military m/v should be the result of these evaluations, and which criteria should be taken into account when selecting persons as evaluators who can get involved in the process of evaluating the performance of military driver m/v? In order to define the criteria that should be considered in the selection of these persons, a group of experts, which consisted of twenty officers of the traffic service, hereinafter EKSG, was interviewed. The survey was conducted in two rounds. In the first round of the survey a

questionnaire, by which they are supposed to provide proposal criteria for selection of evaluator, was sent to the experts. Analysis of the results obtained by examination of the questionnaires showed that proposals of EKSG members regarding the criteria for the selection of persons who can, as evaluators, be involved in process of evaluating the performance of drivers of military m/v mainly relate to:

- Knowing the work that driver carryout;
- Better insight into chores drivers perform;
- Objectivity (impartiality) during the evaluation process;

In accordance with these proposals three so-called "selection criteria" were defined:

- K1 - Knowing the work;
- K2 - Insight into the work;
- K3 - Objectivity of the evaluation;

To validate the proposed selection criteria, in the second round of the survey, the members of EKSG received questionnaire where they were supposed to give their opinion on the validity of the proposed criteria for the selection of evaluators. The results of the survey by this questionnaire fully confirmed (100%) consistency of members of EKSG that persons who participate in the role of evaluator in the process of evaluating the performance of drivers of military m/v should be selected on the based on these 3 criteria.

As the decision on the selection of persons who should be involved, as evaluator, in the process of evaluating the performance of drivers of military m/v, should be made taking into account the multiple (three) criteria, in this paper decision implemented methodology for multi-criteria analysis and ranking known as the AHP-Analytical Hierarchy process (Analytic Hierarchy process) is used and at group level.

2. METHODOLOGY AHP GROUP DECISION MAKING

Analytic Hierarchy Process (Saaty, 1980) is the worlds most used multi-criteria analysis method for assistance in individual and group decision making (Subramanian & Ramanathan, 2012; Bernasconi, Choirat & Sherry, 2014). The method is "analytical" and "hierarchical "because the decision-maker breaks down a complex decision making problem into the several elements establishes a hierarchy between them. Popularity AHP method in the world originates primarily from its fundamental quality: "Always compare two elements of decision-making in pairs and use a simple semantic scale with only five basic graduation degrees of importance (equal, little more important, more important, much more important, absolutely important)". In this way, the method is approximated to person who basically does not have to have an interest in "mathematics" on which the AHP scientifically based on and recognized.

Example below applies Saaty's group decision making principles in AHP method:

- Number of group members is $K \geq 2$;
- The problem hierarchy is pre-defined with the global aim of the top level, the criteria on the lower level and a set of alternatives at the bottom level;
- Standard Saaty's scale given in Table 1 is used;
- Individually obtained weight values of alternatives are geometrically synthesized into the group value according to the consistency demonstrated by the group members in the individual AHP evaluation hierarchy. Consistency is calculated according to the Saaty's methodology, and a weight of the group members is determined by the normalization of individual reciprocal coefficients of consistency.

Table1: Saaty's scale of relative importance

Definition	**Numerical equivalent (a_{ij})**
The absolute dominance of the element i over the element j	9
Very strong dominance of the element i over the element j	7
Strong dominance of the element i over the element j	5
Poor dominance of the element i over the element j	3
The same importance of the element i and the element j	1
Poor dominance of the element j over the element i	1/3
Strong dominance of the element j over of the element i	1/5
Very strong dominance of the element j over the element i	1/7
The absolute dominance of the element j over the element i	1/9
(Intermediate values)	(2,4,6,8)

Since all decision makers (DM) made their evaluation, information base is complete, and a group synthesis was performed by consolidating individual priorities (Aggregation of Individual Priorities - AIP) using geometric averaging method (Geometric Mean Method - GMM):

(1)

where:

- weighted value of alternative to A_i awarded by k^{th} member of the group (k = 1,2, ..., m)
- overall composite weight of alternative Ai
- t - weight of k^{th}

Single weigh of $\alpha_k -$ t group members needed to be previously additively normalized, where supplementary analysis of the performance of individual decision makers, was conducted by using conformity index and Spirman's rank correlation coefficient. When calculating conformity index (C^k) group weight of alternatives obtained by synthesis from individual weights, is adopted as a reference, and then conformity index is calculated for each group member as follows:

... (2)

In the equation (2) k is index group member, K is the number of group members, a superscript ref represents a group weight.

When calculating Spirman's rank correlation coefficient (S) so-called reference list of ranks is used, and any other list is compared with it according to the equation:

———— ... (3)

is the difference between U_a i V_a and where U_a i V_a are ranges for an alternative a according to the reference list and according to the list that compares to the reference list, and n is the number of alternatives. In a group context, the equation (3) is applied to each of the combinations (group list, a list of the k^{th} group member) i.e. one need to calculate as many Spirman's coefficients as there are members of the group, same as with conformity index. Value of Spirman's coefficient can vary between theoretical values -1 and 1. When the value is closer to 1, the indication is that the ranks are similar or the same, and when the value is less than zero and closing - 1 ranks are reversed, i.e. negatively correlated.

3. PROBLEM SETTING AND THE INDIVIDUAL AHP EVALUATION

Problem decided by EKSG consists of three hierarchical levels. Five persons who participate in the role of evaluators in the process of evaluating the performance of drivers of military m/v were assessed according to 3 criteria, Figure 1.

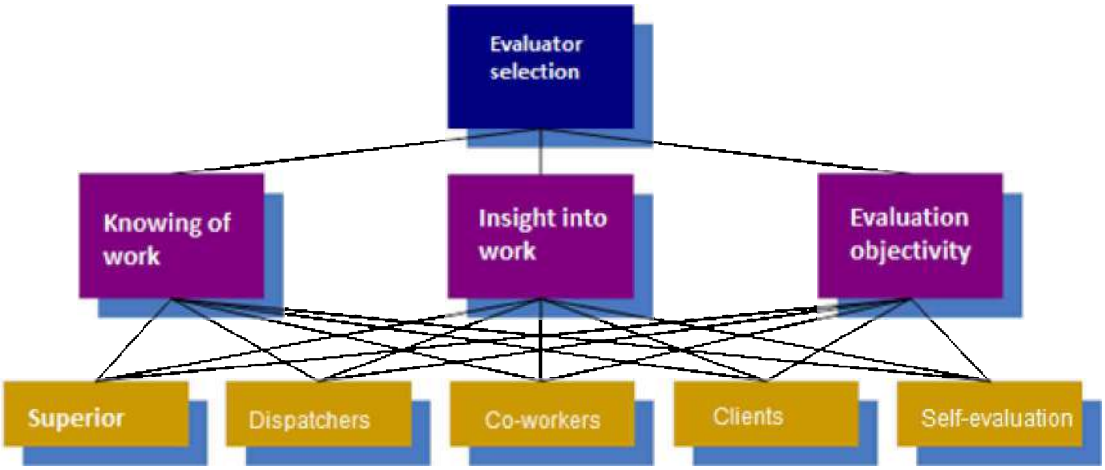


Figure 1: The hierarchy of decision problems

The aim is to "select the evaluator," and it is on top of the hierarchy. Selection criteria are the following - the middle level, and alternative (persons who participate in the role of evaluators), which is subject to selection are at the lowest level of the hierarchy:

- A1 - superior
- A2 - Dispatchers;
- A3 - Colleagues;
- A4 - Clients;
- A5 - Self-evaluation;

With each DM a complete personalized AHP stage consisting of the following steps (Lukovac, 2010) was conducted:

1. The hierarchy in Figure 1 was shown in a short interview and the elements of the hierarchy were explained;
2. The procedure of AHP evaluating was explained i.e. instructions on how to evaluate elements of the hierarchy using Saaty 's Scale in Table 1, were given;
3. The form with comparison matrix for AHP comparison of hierarchy elements in pairs using Saaty 's Scale was delivered;
4. Participants were informed that the results from the comparison matrixes would be processed by the software Expert Choice 2000 (EC 2000), which automatically calculates reciprocal value, and consequently in the comparison matrixes only elements in so-called upper triangles of the comparison matrixes should be evaluated;
5. It was also announced that after the completion of the AHP evaluation, DM would be informed on the final result of decision he made on the problem and about the degree of consistency that he demonstrated, which was also automatically calculated by the software EC 2000.

Final results of the individual evaluations of decision makers are shown in Table 2. Results are obtained by processing data from the comparing matrix by the EC in 2000. In the far right column overall degree of consistency (CR) is given, by which, in an indirect way, according to established methodology AHP (Saaty, 1980), the consistency of decision-making in respect of transitive rules such as "If A has strong dominance over B (numerical preference equal to 5; see Table 1), and B is of

equal importance as the C (numerical preference is 1; see Table 1) then A has strong dominance over C (numerical preference equal to 5)", was presented. Mathematically, complete consistency is achieved if a_{AB}=5 and a_{BC}=1 than a_{AC}=$a_{AB}a_{BC}$=5x1=5. If this rule is violated in any way, it results inconsistency. If anywhere in AHP within the entire hierarchy the smallest inconsistency occurs, the level of CR is greater than zero. According to (Saaty, 1980), it is considered that for the CR less than 0.10 consistency is satisfactory.

Table 2: Individual evaluation of DM

EKSG	Alternatives					CR
	0.351	0.351	0.165	0.066	0.068	0.02
	0.352	0.334	0.176	0.052	0.085	0.05
	0.433	0.257	0.171	0.055	0.083	0.05
	0.39	0.287	0.172	0.068	0.082	0.03
	0.424	0.253	0.181	0.045	0.098	0.03
	0.341	0.313	0.193	0.054	0.099	0.04
	0.336	0.378	0.15	0.053	0.083	0.05
	0.307	0.307	0.233	0.064	0.089	0.03
	0.303	0.303	0.203	0.067	0.127	0.02
	0.312	0.268	0.217	0.067	0.135	0.02
	0.33	0.33	0.17	0.068	0.101	0.02
	0.34	0.307	0.181	0.073	0.099	0.02
	0.286	0.286	0.224	0.076	0.128	0.01
	0.301	0.301	0.198	0.076	0.124	0.01
	0.317	0.317	0.213	0.066	0.088	0.02
	0.329	0.292	0.218	0.054	0.107	0.02
	0.319	0.319	0.211	0.067	0.084	0.01
	0.36	0.316	0.168	0.071	0.085	0.02
	0.405	0.284	0.16	0.057	0.094	0.02
	0.388	0.301	0.177	0.054	0.079	0.02

Ranges of individual evaluation of alternatives by the members EKSG are shown in Table 3.

Table 3: Ranges of individual evaluation of alternatives

EKSG	Alternatives				
	1-2	1-2	3	5	4
	1	2	3	5	4
	1	2	3	5	4
	1	2	3	5	4
	1	2	3	5	4
	1	2	3	5	4
	2	1	3	5	4
	1-2	1-2	3	5	4
	1-2	1-2	3	5	4
	1	2	3	5	4
	1-2	1-2	3	5	4
	1	2	3	5	4
	1-2	1-2	3	5	4
	1-2	1-2	3	5	4
	1-2	1-2	3	5	4
	1	2	3	5	4
	1-2	1-2	3	5	4
	1	2	3	5	4
	1	2	3	5	4
	1	2	3	5	4

4. SYNTHESIS OF INDIVIDUAL AHP EVALUATION

Group synthesis of individual weight vectors listed in Table 2 was performed AIP GMM method according to the form (1). DM weights were obtained by normalizing the reciprocals of the individual degrees of consistency (CR) (Srđević, 2008), and are shown in table 4.

Table 4: Weights decision makers

EKSG	CR	Weights (α_k)
	0.02	0.0508
	0.05	0.0203
	0.05	0.0203
	0.03	0.0338
	0.03	0.0338
	0.04	0.0254
	0.05	0.0203
	0.03	0.0338
	0.02	0.0508
	0.02	0.0508
	0.02	0.0508
	0.02	0.0508
	0.01	0.1015
	0.01	0.1015
	0.02	0.0508
	0.02	0.0508
	0.01	0.1015
	0.02	0.0508
	0.02	0.0508
	0.02	0.0508

When the weights listed in Table 4 are used for the group synthesis of individual vectors DM from Table 2, by using AIP GMM method according to the equation (1), a group decision is obtained as shown in Table 5.

Table 5: Weights alternatives and ranks according to the AIP GMM

AIP GMM	Alternatives				
Weight	0.336	0.305	0.194	0.065	0.100
Rank	1	2	3	5	4

In order to analyze the individual performance of DM, values of the conformity index (C^k) and Spirman's rank correlation coefficient (S) were calculated. Conformity index was calculated according to equation (2) and Spirman's rank correlation coefficient by the software IBM SPSS Statistics 22. The values of conformity index and Spirman's DM correlation coefficient are shown in Table 6.

The values of conformity index of (0.026-0.195) show a small deviation of individual decisions from group decisions. The lowest level of conformity (0.026) was at which means that his deviation of weight values of alternative from their group weight value is slightest. , DM_{16}, DM_{15} follow and so on up to with the highest conformity index (0.195). Based on the values Spirman's rank correlation coefficient (0.900-1.000), it can be concluded that the individual decisions are in correlation with the group decision. Even eleven DM has equally ranked all alternatives (comparing to a group decision) ($S = 1.000$).

Table 6: Conformity index and Spirman's rank correlation coefficient

EKSG		
	0.123	0.975
	0.091	1.000
	0.195	1.000
	0.115	1.000
	0.175	1.000
	0.026	1.000
	0.146	0.900
	0.082	0.975
	0.073	0.975
	0.121	1.000
	0.059	0.975
	0.028	1.000
	0.138	0.975
	0.078	0.975
	0.063	0.975
	0.062	1.000
	0.066	0.975
	0.082	1.000
	0.138	1.000
	0.105	1.000

5. CONCLUSION

Each possible choice of those who should be assigned the role of evaluator in the process of evaluating the performance of employees has its advantages and disadvantages with regard to evaluation quality. For whom would the organization decide, depends on a number of factors: organizational design, management style, goals set and information that are desired. This paper shows how known method of multi-criteria analysis- AHP could be used for this purpose. The method is interesting because in addition to individual analysis it allows easy expansion to the group context.

This paper considers situation where the problem of selection of persons who should be, as evaluators, involved in the process of evaluating the performance of drivers of military m/v, was decided by 20 individuals. Identified as DM_1–DM_{20} decision makers individually used AHP, and then the context of decision-making was extended to the group. Since the group decision making allows numerous variants of handling the process, one of the most important is that the individual DM was assigned relative weight and thus possibly favoring one over the others in forming a group decision. It should be noted the difference between the terms "common" and "group" decision. In the first case consensus is implied, but it is not necessarily in another. Group context that is considered in this paper entirely corresponds to the second case, i.e. there was no harmonization or consultations among the participants, and the results of individual evaluations were summarized later. In order to maximally objectify group context in the synthesis of individual decision, decision makers were assigned weights that were corresponded with manifested levels of the individual consistency.

The results of the process of aggregation of the individual to the group decision and measurement in each case of conformity and rank – distance according to Spirman in relation to the derived group decision, shows that AHP methods produce logical results in a multi-criteria tasks directly expressed or hidden conflicts. Additional analysis would allow, for example, drawing of conclusions about the effects of classification of DM into subgroups according to the consistency and then the subsequent synthesis sub-group decisions in a group decision, or the elimination of some DM (DMs) from the decision-making process because of the reported inconsistencies, etc.

REFERENCES

Bernasconi, M., Choirat, C., & Seri, R. (2014). *Empirical properties of group preference aggregation methods employed in AHP: Theory and evidence.* European Journal of Operational Research 232 (3), 584-592.

Lukovac, V. (2010). *A model for evaluating the quality of military drivers,* thesis, Faculty of Traffic Engineering, Belgrade.

Noe, AR, Hollenbeck, RJ, Gerhart, B., & Wright MP (2006). *Human Resource Management,* Third Edition, MATE doo, Zagreb, 2006.

Saaty, TL (1980). *The Analytic Hierarchy Process,* McGraw-Hill, New York, in 1980.

Srđević, B., Suvočarev, B., & Srđević, Z. (2008). *AHP group decision without consensus: Example planning segmentation wet fields.* Waterpower engineering 40 (231-233), 51-58.

Subramanian, N., & Ramanathan, R. (2012). *A review of applications of Analytic Hierarchy Process and operations management.* International Journal of Production Economics 138 (2), 215-241.

MULTICRITERIA DECISION MAKING - PRACTICAL EXAMPLE OF AHP BASED APPROACH FOR SUPPLIER SELECTION

Jovana Mihailovic*[1]
[1]Vip mobile d.o.o.
*Corresponding author, e-mail: j.mihailovic@vipmobile.rs

Abstract: *Paper presents multi-criteria decision making problem of supplier selection. When evaluating and choosing the best supplier, decision maker faces complex task that usually consists of analysing many qualitative and quantitative conflicting performance measures. On practical example applied in one company from Belgrade, this paper describes how decision maker can chose best supplier by using Analytical Hierarchical Process and software Expert Choice. This study identifies criteria used for decision making, alternatives, and presents Expert Choice calculation and sensitivity analysis of solution.*

Keywords*: multi-criteria decision making, AHP method, supplier selection, Expert Choice*

1. INTRODUCTION

The goal of multi-criteria decision making (MCDM) techniques is to help decision maker choose the best option among set of alternatives, by analysing them from different angles or attributes. Ideal situation would be if one had alternative best by all criteria. However, almost every real life example consists of intangible and conflicting criteria and evaluating alternatives is rather complex task.

Since 1970s, MCDM has undergone rapid development and has become a hot research topic. Today there are more than hundred different MCDM techniques and their variations, and this lead to conclusion that choosing right MCDM method has become a decision problem itself (Saaty & Ergu, 2015). Some of the most popular MCDM techniques are the Analytic Hierarchy Process (AHP), the Analytic Network Process (ANP), Technique for Order Preference by Similarity to ideal Situation (TOPSIS), ELimination Et Choix Traduisant la REalité (ELECTRE), Preference Ranking Organization METHod for Enrichment Evaluations (PROMETHEE), VIKOR method, Simple Multiattribute Rating Technique (SMART) and Decision-Making Trial and Evaluation Laboratory (DEMATEL).

Different authors have presented comparisons of different decision making techniques in their researches (Velasquez & Hester, 2013, Chai, Liu & Ngai, 2013, Hodgett. 2015). It is hard to estimate which MCDM technique is the best since many methods can lead to different results when dealing with identical problem. It is difficult to classify, evaluate, and compare different MCDM methods because they are based on a variety of assumptions about the decision maker's preferences and use different types of preference information (Saaty & Ergu, 2015).

AHP appeared to be one of the most prominent methodologies used to address the problem of multi-criteria decision making (Bruno et al, 2012, Chai Liu & Ngai, 2013, Hodgett. 2015, Bentes et al, 2012). Literature review has showed wide use and numerous applications of AHP method. AHP was used to solve problems in: business planning, resource allocation, organisation priority setting, and selection (Bhushan & Rai, 2004), total quality management, business process reengineering, quality function deployment. The Ford Motor Company used the AHP (1999) to establish priorities for criteria that improve customer satisfaction. IBM used AHP in the design and marketing of its successful midrange AS 400 computer (1991). AHP had significant role in creating agreement called the Pittsburgh Principles in Israeli-Palestinian conflict (2011). Some of the reasons AHP method has wide use are its simplicity (decision maker compare only two objects at the time), it is adaptable (this is possible because of hierarchical structure) and it is supported by user friendly software package commercially available. Additionally, it can be used in combination with many other approaches: Data Envelopment Analysis- DEA (Liu & Hai, 2005), fuzzy set theory (was investigated by Chan & Kumar, 2007), genetic algorithms (Rao, 2007), Balanced Scorecard - BSC (nice example of applying AHP and BSC in measuring organisational performance was presented in Bentes et al, 2012).

1.1. Supplier selection- multi-criteria decision making problem

Supplier selection is process that includes acquisition of required material, services and equipment for all types of businesses. Evaluating vendors is complex procedure that requires analysis of multiple tangible and intangible criteria and many alternatives. Almost every company deals with supplier selection problem and criteria used for evaluation are usually based on cost, quality and vendor ability to meet the deadline and keep up with schedule. MCDM techniques can be used to support decision makers in supplier evaluation and their final judgment of choosing the best alternative. AHP method was evaluated as the most used methodology in supplied selection problem (Bruno et al, 2012, Chai Liu & Ngai, 2013). This can be explained by observing some of the strengths of AHP: it has ability to structure problem hierarchically which facilitates decision maker analysis since he investigates each level of hierarchy separately, AHP can handle both tangible and intangible attributes and characteristics, it is possible to monitor consistency decision maker has when making judgement and it can be used in combination with many other approaches.

This paper should highlight the need to use MCDM techniques in corporate environment. The goal is to solve supplier selection problem by using AHP method and software package Expert Choice. This is shown on practical example applied in one company in Belgrade. Paper is organised in four sections. Following introduction, section 2 describes theoretical framework of AHP method. Section 3 presents application of AHP on supplier selection problem: criteria for supplier evaluation and alternatives are defined and structured hierarchically (3), attributes and alternatives are evaluated in 3.1 and 3.2, results, sensitivity analysis and discussion is shown in 3.3.

2. ANALYTICAL HIERARHICAL PROCESS

AHP is decision making approach that helps decision maker solve complex problem consisting of multiple conflicting criteria both quantitative and qualitative and multiple alternatives. Modeling process consists of following steps:

- Problem structuring
- Comparative judgements and weights evaluation
- Calculation of global score
- Sensitivity analysis

Like in all MCDM processes, first challenge is to structure the problem, which means to define goal, criteria and alternatives. One of the advantages of AHP method is the fact that it structures attributes in hierarchy. This provides decision maker better focus on specific criteria and sub criteria and simplifies allocating the weights.

Second phase begins with data collection and measurement. Decision maker does pairwise comparisons at each node of hierarchy. Psychologist argue that it is easier and more accurate to express one's opinion on only two alternatives than simultaneously on all alternatives (Ishizaka & Labib, 2009). To compare two attributes and characteristics *i* and *j* the ratio scale illustrated in Table 1 is used.

Table 1: Ratio scale of comparative judgements (Saaty, 1977)

Intensity of importance	Definition	Explanation
1	Equal importance	*i* and *j* are equally important
3	Weak importance of one over another	*i* is slightly more important than *j*
5	Strong importance	*i* is much more important than *j*
7	Very strong importance	*i* is by far much more important than *j*
9	Absolute or extreme importance	*i* is definitely much more important than *j*
2, 4, 6, 8	Intermediate values between 2 adjacent judgements	
Reciprocals of above nonzero	If activity *i* has one of the above nonzero numbers assigned to it when compared to activity *j,* then *j* has the reciprocal value when compared to *i*	

Next step is determining relative weights of attributes. Assume *n* attributes $A_1, A_2 \dots A_n$ with known worth $w_1, w_2 \dots w_n$. Matrix of ratios is shown on Table 2. To recover the scale *w* from the matrix of ratios *A*, one must solve the eigenvalue problem shown in Equation 1:

$$Aw = nw \text{ or } (A - nI)w = 0 \tag{1}$$

Table 2: Matrix of ratios

$$\begin{array}{c} \\ A_1 \\ A_2 \\ \\ A_n \end{array} \begin{array}{c} \begin{array}{cccc} A_1 & A_2 & & A_n \end{array} \\ \begin{bmatrix} \frac{w_1}{w_1} & \frac{w_1}{w_2} & \cdots & \frac{w_1}{w_n} \\ \frac{w_2}{w_1} & & \ddots & \vdots \\ \vdots & & & \\ \frac{w_n}{w_1} & \frac{w_n}{w_2} & \cdots & \frac{w_n}{w_n} \end{bmatrix} \end{array}$$

Table 3: Equation to get back the scale

$$\begin{bmatrix} \frac{w_1}{w_1} & \frac{w_1}{w_2} & \cdots & \frac{w_1}{w_n} \\ \frac{w_2}{w_1} & & \ddots & \vdots \\ \vdots & & & \\ \frac{w_n}{w_1} & \frac{w_n}{w_2} & \cdots & \frac{w_n}{w_n} \end{bmatrix} \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{bmatrix} = n \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{bmatrix}$$

In general case when only judgements but not the numbers are available, precise value of $\frac{w_i}{w_j}$ is not known, instead only an estimate of it can be given as a numerical judgement from the scale in Table 1 (Saaty, 2013). The maximum eigenvalue is no longer equal to *n* but is replaced by the maximum eigen value of matrix of judgements, λ_{max} (Table 4 and Table 5). The solution is obtained from the Equation 2:

$$A' w' = \lambda_{max} w' \tag{2}$$

Table 4: Matrix of ratios

$$A' = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ \frac{1}{a_{12}} & & & \\ \vdots & & \ddots & \vdots \\ \frac{1}{a_{1n}} & \frac{1}{a_{2n}} & \cdots & 1 \end{bmatrix}$$

Table 5: Equation to get the scale of priorities

$$\begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ \frac{1}{a_{12}} & & & \\ \vdots & & \ddots & \vdots \\ \frac{1}{a_{1n}} & \frac{1}{a_{2n}} & \cdots & 1 \end{bmatrix} \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{bmatrix} = \lambda_{max} \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{bmatrix}$$

The consistency index (CI) and the consistency ratio (CR) measure the degree to which judgements of decision maker are not coherent. Saaty (1977) has proposed a CI which is related to eigenvalue method:

$$CI = \frac{\lambda_{max} - n}{n-1} \tag{3}$$

$$CR = \frac{CI}{RI} \tag{4}$$

RI stands for random index (average CI of 500 randomly filled matrices (Saaty, 1977)). Satisfactory degree of consistency is when CR is less than 10%.

Once local priorities are calculated they should be synthetized across all criteria to determine the global priority. This is done by additive aggregation.

The last step in this model is the sensitivity analysis. The aim of it is to observe the results when input data are slightly modified. If the ranking does not change, the results are said to be robust.

3. SUPPLIER SELECTION – PRACTICAL USE OF AHP METHOD

Practical use of AHP method is demonstrated on example in company MBT Concept. Best supplier was chosen with the help of software Expert Choice. Problem solving steps follow the steps of AHP method: defining goal, defining criteria and sub-criteria, defining alternatives, pairwise comparison of attributes, and pairwise comparison of alternatives according to each criteria, aggregation of local results and sensitivity analysis.

Company is the consultant for procurement of FF&E (furniture, fixtures and equipment) and at the time of study company had big project going on which included choosing vendors for hotel furniture. Choosing best supplier is challenging task that requires observation and evaluation of many qualitative and quantitative criteria, so commercial management team was proposed to use AHP method in order to help them in selection process. Several meetings were organised with commercial management team. In the beginning they were familiarised with AHP method, how it can be applied and all the parts they have to participate in. First challenge was to define criteria and arrange them in hierarchical structure. Some authors have proposed set of attributes that can be chosen for supplier selection (Sung & Ramayya, 2008). This paper was used as starting point for identifying criteria, however the final set of attributes was defined according to the needs of the company. Most important criteria this company values when choosing supplier were recognized together with commercial director and procurement manager. In this study agreement based approach was used, since only two representatives from the company were participating in analysis. Constructive dialogue conducted during the meetings lead to common understanding and decisions. Criteria used for evaluation were divided in three groups: Service level, Quality, Financial conditions. Indicators for Service level were: delivery time (time supplier needs to produce, transport and install furniture), job knowledge (how well informed and professional are vendor representatives), flexibility (how fast can supplier respond to changes in specifications), previous experience (if company cooperated with vendor in the past how satisfied they were). Quality child attributes were: design (similarity between offered and designed furniture), warranties (duration of guarantee period), quality of material (quality of fabrics, woods and other material used in construction of furniture), references (big projects company worked on, especially hotels). Financial conditions were divided into: product price (fee of offered furniture), advance payment (the required amount of advanced payment), other conditions (at which point supplier required full payment). Hierarchical structure of supplier selection problem is presented on figure 1.

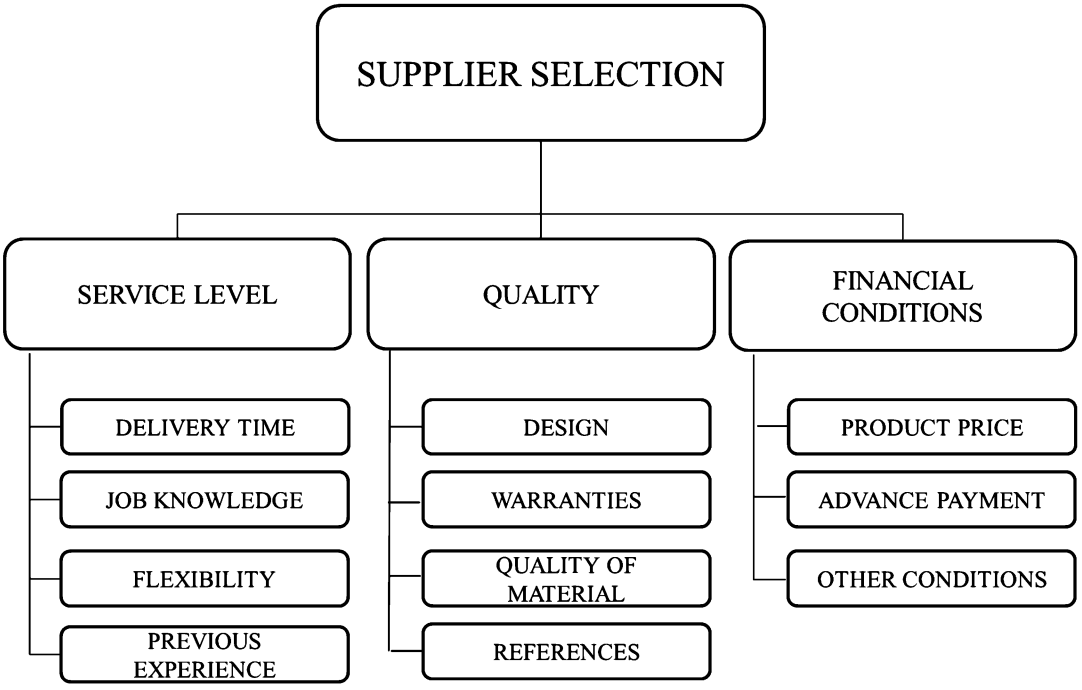


Figure 1: Hierarchical structure of supplier selection problem

In this case study three suppliers were evaluated. Due to data privacy vendors are defined as: Supplier A, Supplier B, Supplier C. Authors are familiar with companies names as well as with their proposals.

3.1. Supplier selection criteria evaluation

After attributes are defined and placed in hierarchical structure pairwise attribute comparison is performed on each level of hierarchy. Ratio scale from table 1 was used as shown on figure 2

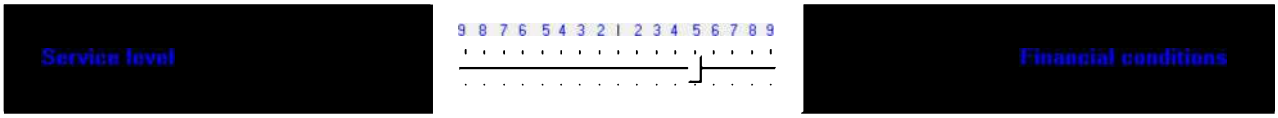


Figure 2: Numerical scale in Expert Choice

Decision makers were advised to use scales: 1, 3, 5, 7, 9, and in the case they were hesitating between two to pick number in the middle. Comparison values and derived local and global priorities are shown on table 6. Consistency ratio was checked in each comparison matrix, and its level was always less or equal to 0.1.

Table 6: Criteria evaluation

SUPPLIER SELECTION	Service level	Quality	Financial conditions	Priority
Service level	1	1/4	1/5	0.093
Quality	4	1	1/3	0.280
Fin. conditions	5	3	1	0.627

IC=0.08

SERVICE LEVEL	Delivery time	Job knowledge	Flexibility	Previous experience	Local priority	Global priority
Delivery time	1	4	5	1/2	0.354	0.033
Job knowledge	1/4	1	1/2	1/3	0.091	0.008
Flexibility	1/5	2	1	1/4	0.112	0.011
Prev.experience	2	3	4	1	0.443	0.041

IC=0.09

QUALITY	Design	Warranties	Quality of material	References	Local priority	Global priority
Design	1	1	1	1	0.250	0.070
Warranties	1	1	1	1	0.250	0.070
Quality of m.	1	1	1	1	0.250	0.070
References	1	1	1	1	0.250	0.070

IC=0

FINANCIAL CONDITIONS	Product price	Advance payment	Other conditions	Local priority	Global priority
Product price	1	8	7	0.777	0.487
Advance pay.	1/8	1	1/3	0.070	0.044
Other condition	1/7	3	1	0.153	0.096

IC=0.1

One can notice that financial conditions are by far most important evaluation criteria, influencing the final decision by 62.7%. As expected most important second level attribute is product price and it influences 48.7% total ranking.

3.2. Supplier evaluation

Supplier evaluation is performed after pairwise comparison of criteria is finished and their local and global priorities are calculated. Comparison is done by each criteria (Figure 3). Results are shown in table 7.

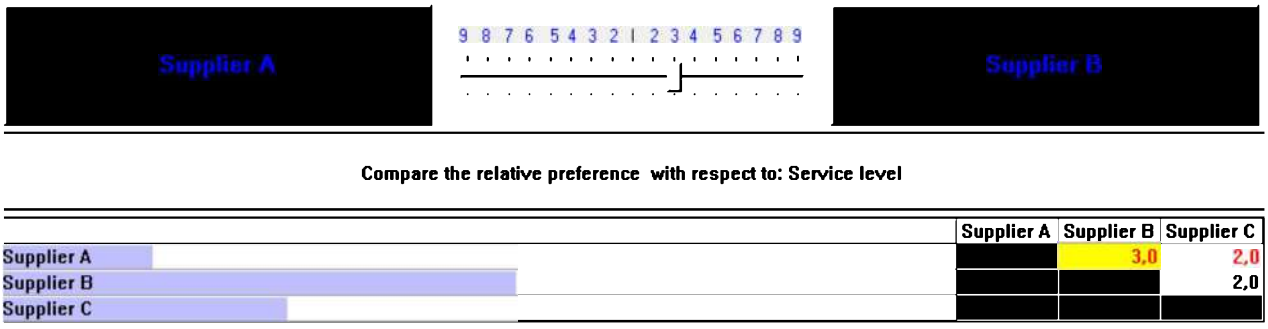


Figure 3: Supplier comparison in Expert Choice

Table 7: Supplier evaluation

Deliv.t.	Sup. A	Sup. B	Sup. C	Priority
Sup. A	1	1/3	1/2	0.163
Sup. B	3	1	2	0.540
Sup. C	2	1/2	1	0.297

IC=0.1

Flex.	Sup. A	Sup. B	Sup. C	Priority
Sup. A	1	1/2	2	0.297
Sup. B	2	1	3	0.540
Sup. C	1/2	1/3	1	0.163

IC=0.08

Know.	Sup. A	Sup. B	Sup. C	Priority
Sup. A	1	1	3	0.429
Sup. B	1	1	3	0.429
Sup. C	1/3	1/3	1	0.143

IC=0

P. exp.	Sup. A	Sup. B	Sup. C	Priority
Sup. A	1	1	1	0.333
Sup. B	1	1	1	0.333
Sup. C	1	1	1	0.333

IC=0

Design	Sup. A	Sup. B	Sup. C	Priority
Sup. A	1	2	5	0.570
Sup. B	1/2	1	4	0.333
Sup. C	1/5	1/4	1	0.097

IC=0.02

Warran.	Sup. A	Sup. B	Sup. C	Priority
Sup. A	1	1	1	0.333
Sup. B	1	1	1	0.333
Sup. C	1	1	1	0.333

IC=0

Q. mat.	Sup. A	Sup. B	Sup. C	Priority
Sup. A	1	2	4	0.558
Sup. B	1/2	1	3	0.320
Sup. C	1/4	1/3	1	0.122

IC=0.02

Ref.	Sup. A	Sup. B	Sup. C	Priority
Sup. A	1	2	5	0.582
Sup. B	1/2	1	3	0.309
Sup. C	1/5	1/3	1	0.109

IC=0

Price	Sup. A	Sup. B	Sup. C	Priority
Sup. A	1	1/3	1/4	0.143
Sup. B	3	1	1/2	0.286
Sup. C	4	2	1	0.571

IC=0.02

Adv. p.	Sup. A	Sup. B	Sup. C	Priority
Sup. A	1	1	1	0.333
Sup. B	1	1	1	0.333
Sup. C	1	1	1	0.333

IC=0

Other c	Sup. A	Sup. B	Sup. C	Priority
Sup. A	1	1/4	1/2	0.143
Sup. B	4	1	2	0.571
Sup. C	2	1/2	1	0.286

IC=0

3.3. Results and discussion

In previous chapter one can observe supplier order by each examined attribute. However it is very hard to tell which supplier is the best in total. Overall best supplier, or final result of evaluation is presented on Figure 4.

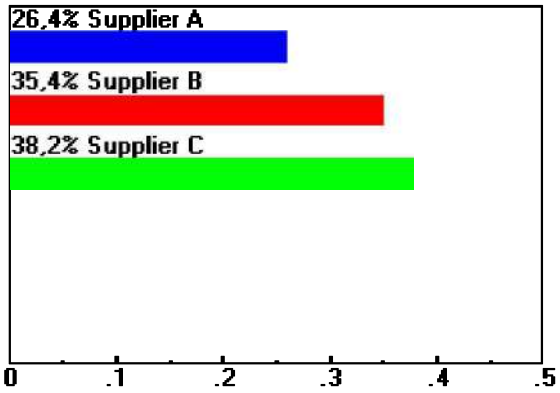


Figure 4: Supplier evaluation results

Supplier with the best total grade is Supplier C with 0.382, second is Supplier B with 0.354 and last is Supplier A with 0.264. Figure 5 demonstrates supplier ranking in more detail and one can observe supplier order by service level, quality and financial conditions. Supplier C is by far better than any other supplier

regarding financial conditions. On the other hand regarding quality and service level its results are rather poor. As previously mentioned, financial conditions were identified as most influential criteria (62.7%) and only thanks to good price offer they defeated their competition. Supplier B on the contrary was evaluated as best regarding service level, and second regarding quality and financial conditions. The difference between Supplier C and B is only 0.028 or 2.8%.

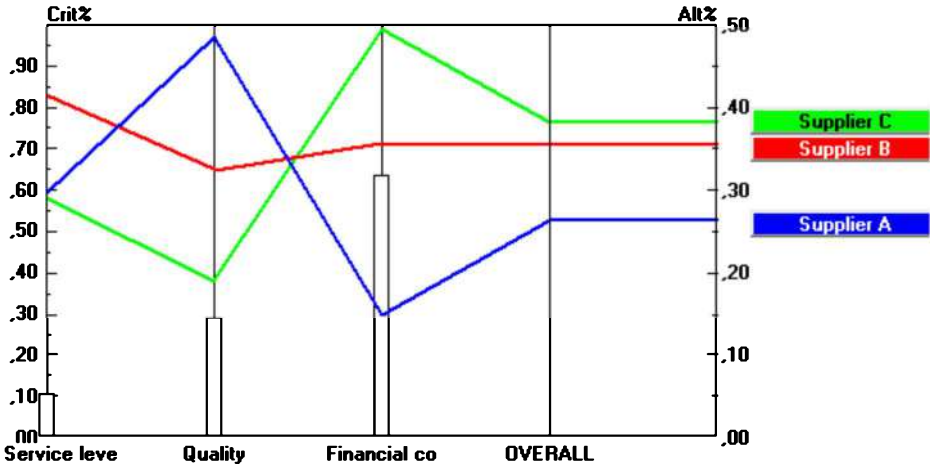


Figure 5: Supplier order by each group of criteria

It is always recommended to perform sensitivity analysis and check if overall ranking changes when the input data changes. Supplier B is better than C by both service level and quality. Expert Choice is very convenient for sensitivity analysis. One can generate Gradient sensitivity graph and observe how supplier ranking can change when priority of criteria changes. Vertical line represents current state and by moving it, variation in alternative order can be observed. It is logical to check result in the case financial priority decreases since financial conditions have highest impact. If the impact of financial conditions drops by 0.1, or by 10%, ranking changes and supplier B is ranked as first (Figure 6). When one criteria ponder drops, some others must be increased, in this case impact of quality and service level increase equally, 5% each.

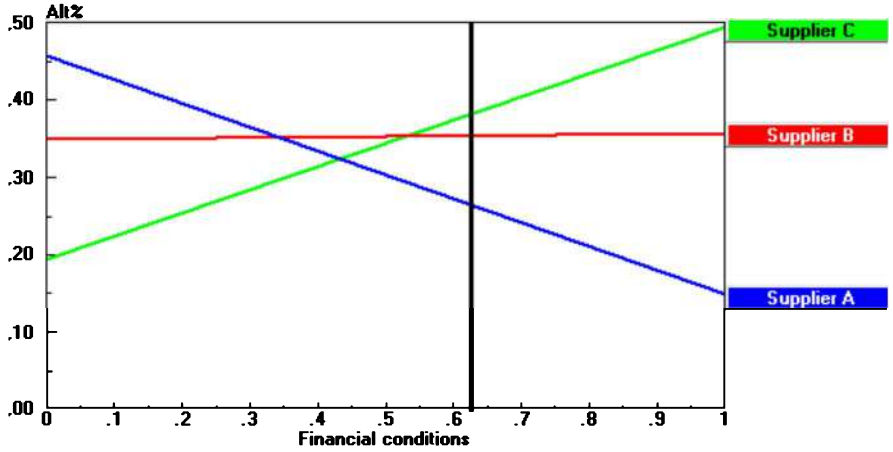


Figure 6: Supplier ranking according to financial conditions ponder

Previous analysis have showed that even though Supplier C was ranked first in overall result, Supplier B seemed to have better performance by more criteria and was serious candidate for winning the job especially after sensitivity analysis. Before showing results, Commercial director was asked to present his feeling about which vendor should be chosen just based on his experience and by analysing offers. He had chosen Supplier B. After seeing results he was more certain in his decision.

Expert Choice was proven to be very useful tool to support judgements when evaluating suppliers. It is very intuitive and easy to use. On the other hand some imperfections were noted. Hierarchical structure in many ways simplifies problem, however when forming it one must be very careful since different structure may lead to different result. Pairwise comparison even though is simple, can be tiring, because one must make a lot of judgements. Additionally it is not easy to choose numbers from Saaty scale. In order to be sure which grade

to grant one must precise criteria for evaluation for each attribute. If compared values are numerical, Expert Choice offers possibility to calculate priority based on their value. In the case of minimization (for example attribute price), priority is calculated based on reciprocal value. In supplier selection example, when Expert Choice was calculating with exact prices, supplier final order was different, Supplier B was first with 35.9%, Supplier C had 34.4%.

4. CONCLUSION

Supplier selection is complex task almost every company faces, and solving it requires analysis of many qualitative and quantitative criteria, usually conflicting, and many alternatives. Companies require finding solution in a quick and simple way. Literature review has showed big interest for supplier selection problem and AHP method appeared to be mostly used and investigated. Due to that fact, in this paper AHP method for supplier evaluation was suggested and applied on practical example in company MBT Concept. First, important criteria were identified and were organised in hierarchical structure. Criteria were divided in three groups: Service level, Quality and Financial conditions. Three suppliers and their offers were analysed and evaluated. Expert Choice proved to be very intuitive and simple to use and was convenient for sensitivity analysis. Final result proved that AHP method can be easily applied and be very helpful in corporate environment to support manages in their decisions. In the last years researchers are trying to combine AHP with other mathematical programming methods such as DEA, genetic algorithm, fuzzy sets, as well as with strategic framework such as SWOT and BSC analysis, so it is assumed that the number of applications of AHP method in different areas in corporate world will grow in the future.

REFERENCES

Bentes et al.. (2012). Multidimensional assessment of organizational performance Integrating BSC and AHP. *Journal of Business Research*, 65(12), 1790-1799.

Bhushan, N & Rai, K. (2004). *Strategic Decision Making: Applying the Analytic Hierarchy Process*. England: Springer-Verlag.

Bruno et al.. (2012). AHP-based approaches for supplier evaluation: Problems and perspectives. *Journal of Purchasing & Supply Management*, 18(3), 159–172.

Chai, J, Liu, J & Ngai, E. (2013). Application of decision-making techniques in supplier selection: A systematic review of literature. *Expert Systems with Applications*, 40(10), 3872–3885.

Chan, F & Kumar, N. (2007). Global supplier development considering risk factors using fuzzy extended AHP-based approach. *Omega*, 35(4), 417–431.

Hodgett, R. (2015). Comparison of Multi-Criteria Decision-Making Methods for Equipment Selection. *The International Journal of Advanced Manufacturing Technology*, 1-13.

Ishizaka, A & Labib, A. (2009). Analytic Hierarchy Process and Expert Choice: Benefits and Limitations. *ORInsight*, 22(4), 201–220.

Liu, F & Hai, L. (2005). The voting analytic hierarchy process method for selecting supplier. *International Journal of Production Economics*, 97(3), 308–317.

Rao, V. (2007). Vendor selection in a supply chain using analytic hierarchy process and genetic algorithm methods. *International Journal of Services and Operations Management*, 3(3), 355-369.

Saaty, T & Ergu, D. (2015). When is a Decision-Making Method Trustworthy? Criteria for Evaluating Multi-Criteria Decision-Making Methods. *International Journal of Information Technology & Decision Making*, 14(6).

Saaty, T. (2013). The Modern Science of Multicriteria Decision Making and Its Practical Applications: The AHP/ANP Approach. *Operations research* , 61(5), 1101–1118.

Saaty, T. (1977). A Scaling Method for Priorities in Hierarchical Structures. *Journal of mathmematical pshychology*, 15, 234–281.

Sung, H & Ramayya, K. (2008). A hybrid approach to supplier selection for the maintenance of a competitive supply chain. *Expert Systems with Applications*, 34(2), 1303–1311.

Velasquez, M & Hester, T. (2013). An Analysis of Multi-Criteria Decision Making Methods. *International Journal of Operations Research*, 10(2), 56-66.

EFFICIENCY EVALUATION OF ABA LEAGUE TEAMS FOR THE SEASON 2012-13 THROUGH DMU CLUSTERING AND DEA

Maja Mitrović*[1]
[1]University of Belgrade, Faculty of Organizational Sciences, Serbia
* Corresponding author: mitrovicmaja4@gmail.com

Abstract: *In this work, Data Envelopment Analysis (DEA) approach measures the efficiency of basketball teams, which played the 2012–13 Adriatic (ABA) League regular season. To apply such methodology, 14 teams were considered as Decision Making Units (DMU), and the algorithm K-means Clustering is used to group teams into homogenous clusters. Then, DEA is applied separately to evaluate efficiency of each team in a specific cluster. The proposed model in the paper is basic BCC DEA model, oriented to outputs, which considered a single input and two outputs. The advantages of the work rest on the fact that presented methodology should help ensuring a greater efficiency of each team, and getting more precise prognoses of sports results.*

Keywords*: DEA methodology, K-Means clustering, efficiency, basketball, ABA-league*

1. INTRODUCTION

As one of the well-known sports in the United States (ReadingTree, 2016), basketball provides a great portfolio for a business platform, which contributes to the great result in finance (Labonté, 2016). Looking at National Basketball Association (NBA), or at the most famous one from Spain - ACB league (ENBR, 2016), sports statistic is of great importance for different groups of people, since it allows many types of analyses. From those matches, as well as from other less popular leagues, available data enhance the chance of better results in the next season if it"s used in a right way.

Using Data Envelopment Analyse (DEA) methodology becomes very popular in recent years. DEA is widely used to measure the efficiency of decision-making units (DMUs). It is possible to find many works which describe how the methodology has been used for performance evaluation in widespread areas in the last decades, from non-profit sector like education and hospitals evaluation (Jeremic *et al.* 2011, Jeremic *et al.* 2012, Savic *et al.* 2012) to profit sector like banks evaluation (Bulajic *et. al*, 2011; Savic *et al.* 2013; Radojicic *et. al*, 2015). Variety DEA studies are also done for different sports, such as football (Tiedemann *et. al.* 2011, Petrovic *et al.* 2015), baseball (Lewis, 2014), and tennis (Ramón & Sirvent, 2012; Ruiz & Pastor, 2013). Many authors used the benchmark methodology with the DEA to show improvements in productivity in sports (Anderson, 2004; Barros & Santos, 2014). For the sake of this work, the most important is efficiency assessment in sports, in particular to basketball.

De Mello (Angulo-Meza & Da Silva, 2009) used basketball as official Olympic discipline, to rank clusters by aggregation of the partial sports. Cooper *et al.* (2009) demonstrate how multiplier values are used to identify major characteristics of individual players. For one of the most popular competitions – NBA, DEA approach is used by Radovanović, Radojičić & Savić (2014). Furthermore, Moreno and Lozano (2014) used DEA to assess the efficiency of NBA teams for the regular season 2009-2010, with the results which show the differences between network DEA and conventional DEA approach. Aizemberg *et al.* (2014) present an analysis of the NBA team for period of five years, using a multi-objective approach, while Alves, et al. (2013) show the efficiency of teams just for one season and ranks them according to composed efficiency score of each DMU, using the inverted frontier method.

For the purpose of this work, the author will analyze a regional professional basketball league, commonly known as the **Adriatic League**. In the recent years, the basic countries which took part were: Serbia, Croatia, Montenegro, Bosnia and Herzegovina and Slovenia. The body that organizes the league is **Adriatic Basketball Association** and the league is also considered as a local version of the Europe-wide Euro league (Aba-league, 2016).

The organization of the league is next: in the regular part of the season, 14 teams are playing. Each team plays against every other team once at home and once away. After 26 played rounds, the best placed 4 teams (also known as „Final Four") are qualified to the playoffs.

The semi-finals are played in the best of three games format (1-1-1), where the first placed team after regular part of the season will face the fourth-placed team in the first semi-final pair and the second placed team after regular part of the season will face the third placed team. The first and the second placed team will have the home court advantage in the semi-finals.

Winners of both semi-final pairs will advance to the finals, which will be played in the best of five games format (2-2-1). There will be no games for the third place played. The finalist, that is the better placed after the regular season, will have the home court advantage (Aba-league, 2016).

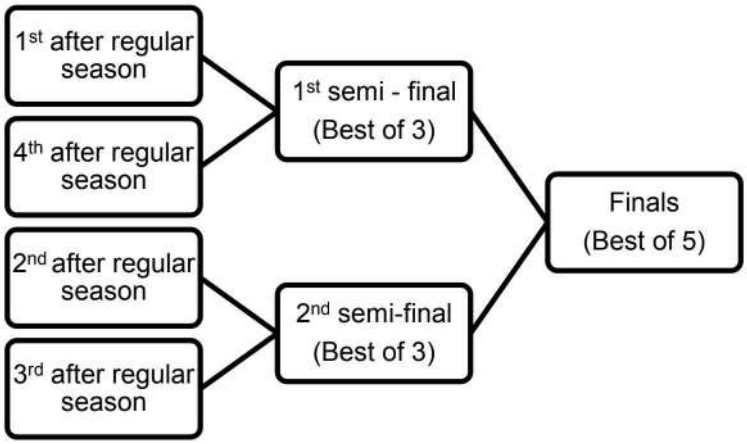


Figure 1: Competition system

This study proposes an efficiency analysis of 14 teams that played the 2012-13 regular season. Moreover, it will be shown clustering via K-Means Clustering algorithm and evaluation of the teams in each cluster using DEA methodology. The concept of clustering consists of grouping the DMUs with similar characteristics. Various authors have used different clustering methods in order to obtain homogeneous clusters (Alves *et al.,* 2013; Ma, Wang & Wang, 2014) and then, apply DEA for assessing efficiency index (Yu & Lee, 2013; Alves *et al.*, 2013; Moreno & Lozano, 2014). In order to improve the efficiency of each team, the author applied DEA methodology, observing the classic efficiency of teams in each cluster using the BCC DEA model (Banker *et al.*, 1984) oriented to output. The goal is to grade DMUs. The obtained results can act as indicators for management, players, but also for civil society to realize what to improve, and to predict the future results in coming seasons in order to get a higher rank of selected team.

The paper is organized as follows. First, the basic concept of the data used is described. Then, in **Section 2** proposed methodology, including the K-means Clustering and fundamental concept of DEA model is given. In **Section 3** the result of the study is shown, as well as its analysis. Finally, concluding remarks of this work are presented.

2. METHODOLOGY

2.1. K-means Clustering

At the beginning of this paper, the author introduces that the matches took place in different Balkan cities, which can intensify the home advantage. Anderson *et al.* (2012) suggest that this factor could significantly affect the performance of teams in different sports. In order to set a homogeneous assessment, the DMUs were grouped in clusters based on circumstances of the cities that hosted their matches.

One of the most widely used algorithm for grouping units is K-means clustering. Tan, Steinbach and Kumar (2013) gave the definition: *"Cluster analysis groups data objects based only on information found in the data that describes the objects and their relationships"(p.490)*. They also argue that, if the similarity within a group is greater, as well as the difference between groups, the clustering is better *(p.490)*.

This work uses the K-means Clustering algorithm for the purpose of grouping teams in homogenous clusters. As a partitioning clustering technique, it uses centroids to specify the number of clusters (K). Centroids are usually the mean of a group of points (Tan, Steinbach, & Kumar, 2013) while K is the user specified number. Each point is assigned to the closest centroid, and the collection of points assigned to a centroid is a cluster. The basic algorithm is given in the following:

- Select K points as initial centroids

- Repeat
    - Form K clusters by assigning each point to its closest centroid
    - Recompute the centroid of each cluster
- Until centroids do not change

In the first iterations, the conversation is the fastest. A measure used to assign a point to the closest centroid is Euclidean (L_2) distance:

$$dist(p,q) = \sqrt{\sum_{i=1}^{n}(p_i - q_i)^2}\,, \tag{1}$$

where *p* and *q* are points and the distance represents the length of their line segment connecting them (Deza & Deza, 2009). In order to minimize the squared distance of each point to its centroid, it's necessary to express objective function. The sum of squared error is a measure of the quality of clustering. The goal is next: to get the smallest total sum of squared errors of each data point:

$$SSE = \sum_{i=1}^{K}\sum_{x \in C_i} dist^2(m_i, x)\,, \tag{2}$$

where *x* is the point from the specific cluster C_i, while m_i is the most representative point for the cluster *C* (Vazirgiannis, Halkidi, & Gunopulos, 2012). It's also possible to use other measures as Proximity function Manhattan (L_1), where Centroid is the median of the points and also minimize the sum of the L_1 distance between an object and its median. Squared Euclidean use means as centroids and minimizes the sum of the squared L_2 distance (Deza & Deza, 2009).

The most followed issues for the previously described measure are Handling Empty Clusters and Outliers (Tan, Steinbach, & Kumar, 2013). Empty clusters can be obtained if no points are allocated to a cluster. Improving the methods allows overcoming the issues (Delibasic *et. al*, 2009; Delibasic *et. al*, 2012). Wang *et. al* (2015) described a new K-Means algorithm to reduce the computational complexity in the assignment step, using multiple random spatial partition trees. An adaptive initialization method (IM) can be used to initialize other partitional clustering algorithms such as fuzzy c-means and its variants (Celebi, Kingravi & Vela, 2013).

2.2. DEA – BCC model

DEA was first developed by Farrel (1957) and improved by Charnes, Cooper & Rhodes (1978) as a non-parametric method that compares a decision making-units directed to frontiers rather than central tendencies, using performance indicators. This tool allows identifying which units are efficient, besides defining benchmarks between such units. DEA has two classical models, which are the CRS (Charnes et al, 1978) and BCC (Banker et al, 1984). The CRS model works with constant returns to scale while the BCC assumes that the DMUs can exhibit variable returns to scale. Both models can work with input orientation, where inputs are minimized while outputs remain unchanged, or can work with output orientation when the objective is to maximize the outputs while inputs do not change.
In this paper, the DEA BCC model was chosen due to the fact that increasing input variable – in this study *Total budget* won't increase the same quantity of output variable. Therefore, the variables do not vary proportionally. The output orientation is preferred since the main purpose of the basketball teams is to have high scores and to win the matches.

Let x_{ij} - denote the observed magnitude of *i* - type input for entity *j* ($x_{ij} > 0$, $i = 1, 2, ..., m$, $j = 1, 2, ..., n$) and y_{rj} - the observed magnitude of *r*-type output for entity *j* ($y_{rj} > 0$, $r = 1, 2, ..., s$, $j = 1, 2, ..., n$). Then, the basic DEA model is formulated in the following form for the selected entity k:

$$(\max)\, h_k = \sum_{r=1}^{s} u_r\, y_{rk} \tag{3}$$

$$\sum_{i=1}^{m} v_i\, x_{ik} = 1 \tag{4}$$

$$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \leq 0, (j = 1,...,n) \quad (5)$$

$$u_r \geq \varepsilon, r = 1,2,..., s$$
$$v_i \geq \varepsilon, i = 1,..., m) \quad (6)$$

Where:

- v_i is the weights to be determined for input *i*;
- *m* is the number of inputs;
- u_r is the weights to be determined for output *r*;
- *s* is the number of outputs;
- h_k is the relative efficiency of DMU_k;
- *n* is the number of entities;
- ε is a small positive value.

The relative efficiency h_k, of one decision-making unit *k*, is defined as a ratio of the weighted sums of their outputs (virtual output) and the weighted sums of their inputs (virtual input). As for the decision-making unit *k*, for which a maximum in the objective function (3) is sought, the condition (4) is true, meaning that it is obviously $0 < h_k \leq 1$, for each DMU_k. The weights v_i and u_r show the importance of each input and output and are determined in the model so that each DMU is efficient as much as possible. Given that the condition (6) is true for every DMU, it means that each of them lies on the efficiency frontier or beyond it. If Max $h_k = h_k^* = 1$, it means that efficiency is being achieved, so we can tell that DMUk is efficient. Efficiency is not achieved for $hk^* < 1$ and DMUk is not efficient in that case. The mathematical model given above is linear and can be solved using any of the familiar programs packages for LP (Martic et al., 2009).

Variable Description

Table 1: ABA league 2012-13 Teams and Variables used for analyses

Team information		***K-Means Clustering***			***DEA***		
		Inputs			*Inputs*	*Outputs*	
Home country	**Team**	**Average home attendance**	**Total kilometres travelled**	**GDP per capita (€)**	**Total budget (mil €)**	**Victories**	**Average score**
Bosnia and Herzegovina	Igokea	2160,00	18072	11,1	2,5	20	46
Bosnia and Herzegovina	Siroki WWin	2807,69	22944	7,963	2,5	9	35
Croatia	Cedevita	1076,92	19160	13,493	7	15	41
Croatia	Zadar	4076,92	24456	17,8	2,5	9	35
Croatia	Cibona	1916,67	19160	13,493	3,7	9	35
Croatia	Split	1861,54	23976	10,47	1,9	8	34
Hungary	Szolnoki Olaj	1600,00	30264	12,39	3	9	35
Macedonia	MZT Skopje	3080,00	35068	3,688	2,5	14	40
Montenegro	Aerodrom Buducnost VOLI	1960,00	26896	5,211	2,8	16	42
Serbia	Crvena Zvezda	5097,07	20896	7,136	4	18	44
Serbia	Telekom Partizan mt:s	5178,57	20896	7,136	4,5	16	42
Serbia	Radnicki	3040,00	24232	7,4	3,25	17	43
Slovenia	Union Olympic	2100,00	24264	10,1	4	13	39
Slovenia	Krka	980,00	21244	17,379	3,7	9	35

ABA league teams are grouped based on the following set of inputs: *Average attendance* at home matches, *Total kilometres* travelled by the team during the regular season and *Average GDP per capita* of host cities. For the purpose of DEA analyses, the author had used *Total budget* (in million euros), as an input variable, and *Number of Victories* followed by obtained *Average Score* as output variables. All of the mentioned variables are shown in **Table 1.**

Average home attendance – defines the level of public participation in the games that occurred in the own city. Higher *home attendance* is correlated with higher *home advantage*; teams with a relatively high *home advantage* perform better in front of larger crowds, while teams with a relatively low *home advantage* perform better in front of smaller crowds (Willoughby, 2014). As a half of the matches were played in team's hall, that increased *home advantage* attendance.

Total kilometres travelled – expresses the distance travelled by each team during the regular season. This variable can also be interpreted as the effort that fans of a team would make in order to attend the match; it should be lower the participation of its fans at the games, as farther the game is played. Scheduling tournament is also important for this point of view because it's directly connected with the team budget (Ribeiro, 2012).

The last variable chosen for clustering – *Average GDP per capita* – is the average GDP per capita of all cities that hosted the games that each team participated. This variable reflects the economic situation of the city's public – how much people would pay for the tickets for the games occurred in their town. Also, it has the direct impact on future participation in sport (Humphreys, Maresova, & Ruseski, 2012).

Total budget - represents the amount of money that each team had for organizing tournament during the season. The budget expresses in which condition is team – if the team has better results, players will be desired by another team, the performance of the team will increase (Lera-López *et. al*, 2013).

The number of victories - shows the main purpose of a team, which is winning the game. Also, another variable which has almost the same meaning is the score reached. Observing this, the author used DEA BSS model oriented to output, in order to maximize score with the minimum of available input.

3. RESULTS AND DISCUSSION

This section presents the results obtained from the application of the proposed approach described in the previous section of this paper. **Table 2** presents the clusters found and the efficiency scores assessed for teams in each cluster.

Table 2: Team country, main cluster, and team efficiency

Home country	City	Team	Cluster	Efficiency
Bosnia and Herzegovina	Široki Brijeg	Siroki WWin	C1	1
Slovenia	Ljubljana	Union Olimpija	C1	0,932
Slovenia	Novo Mesto	Krka	C1	1
Croatia	Zagreb	Cedevita	C2	0,848
Croatia	Zadar	Zadar	C2	0,784
Croatia	Zagreb	Cibona	C2	0,913
Croatia	Split	Split	C2	1
Hungary	Szolnok	Szolnoki Olaj	C2	1
Macedonia	Skopje	MZT Skopje Aerodrom	C2	0,784
Montenegro	Podgorica	Buducnost VOLI	C2	0,77
Bosnia and Herzegovina	Aleksandrovac	Igokea	C3	1
Serbia	Beograd	Crvena Zvezda Telekom	C3	0,875
Serbia	Beograd	Partizan mt:s	C3	0,875
Serbia	Kragujevac	Radnicki	C3	0,85

The methodology of clustering enabled the author to makes groups of units which have some similar characteristics. That provides fair analyses of efficiency since the teams were compared with other teams that played in similar circumstances.

From Cluster 1 teams it can be seen that Krka has the smallest *home attendance*, as well as *total kilometres travelled* during the season, but has the biggest *GDP per capita* in front of other countries. These opposite values put it next to the teams Union Olympia and Siroki WWIn. Interesting is that even Krka has the highest GDP per capita, home matches are not enough known. Higher GDP means better health and education outcomes, better sporting infrastructure and more resources spent for sports (Economictimes, 2016). Siroki WWin has more fans than Union Olympic, but they were less active.

Most of the Cluster 2 teams present low values for the *Average home attendance* and high values related to the average *GDP per capita* of home cities. Climate can play a significant role in home advantage. All Croatian cities have Mediterranean climate with a lot of rain during the year. That involves people to watch the match at home. Skopje had the lowest *GDP per capita* for the year 2013, but urbanization of that city influenced *home attendance*.

On the other hand, Cluster 3 teams played under favourable conditions, since they mostly played in cities with a high average *GDP per capita*, and had a high home advantage. Furthermore, these teams present a middle value looking at *total kilometres travelled*. Played matches between teams in this Cluster were in top 10 attendance (Wikipedia, 2013), since Belgrade is an attractive turist destination.

The second part of the methodology is to calculate the efficiency indexes. The obtained results have shown interesting values about the performance of the teams. The author got in two clusters pairs of teams which have efficiency equal to 1. As the efficient teams from Cluster 1 author can observe Siroki WWin and Krka from Slovenia. Union Olympic considers as an inefficient team because of the amount of budget (4 million Euros) and just 4 matches more victories, as well as 4 points greater average score than Krka. For the season 2012-13 players didn't make game very well, they bypass the top 10 players.

In the Cluster 2, Split and Szolnoki have the efficiency equal to 1. Split had the minimum budget for the season, even 3 times smaller than the highest one, but also had just eight victories more and 4 points more than others. Split and Szolnoki round by round became at the top of the best player. That ends with high scores.

Figure 2 shows Final rank of the teams, as well as achieved points in the final games. It can be seen that all "Final Four" teams are grouped in the same cluster.

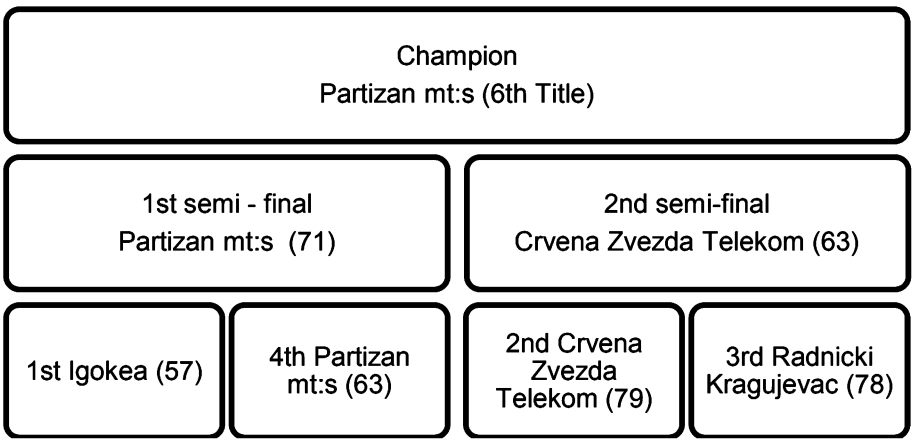


Figure 2: Results and Final rank

From the strongest teams, only Igokea was ranked 1st in its cluster. It's pretty surprisingly because Igokea ranked 2nd in value for variable *Total budget* (in a group with Siroki WWinn, Zadar and MZT Skopje), and ranked 1st based on the *Number of victories* and *Average score*. Even Igokea had the greatest efficiency, that wasn't enough for the victory. Going further, two other teams in the same cluster (Crvena Zvezda Telekom and Partizan mt:s) had almost 2 times the greater budget for the season, but a smaller number of victories and scores. With the same efficiency, the both of teams played in Semi-Final and the champion of the season (Partizan mt:s) was neither first in its cluster. The study also found that Radnicki Kragujevac, the team with the smallest efficiency in it's cluster ranked 3rd looking at the *Number of victories* and *Average scores*.

4. CONCLUSION

In this paper, the author shows through DEA methodology efficiency measures of 14 basketball teams belonging to the ABA league 2012/13 regular season. Since the approach has never been applied on the ABA league before, the author has developed a framework for teams analyses, by clustering the teams into effective DMUs. Another main feature of the proposed approach is to consider the importance of obtained results – how to plan and allocate the budget, or how to enforce the public to support their teams on the upcoming matches.

Regarding teams analysis, the author can observe the performance of teams in each group - Cluster 2 presents the greater difference between maximum and minimum values for each efficiency score, while Cluster 1 presents the lowest difference. All of the teams in Cluster 1 are efficient, and teams with the highest and lowest composed efficiency were grouped in Cluster 2. In this context, the recommendation for the Team management is to consider greater budget for the next regular season, in order to allow better conditions, as well as better performances of the team players.

For the future research work, the author suggests additional analyses of team players, considering the fact that each team belongs to a specific cluster. Another topic of further research can be to evaluate the change in efficiency for every team in a specific period of time. Than, the application of statistical methods could be significant, in order to reduce the number of related problems, such as a high degree of correlation between proposed variables; or to show the most important variables, applying the I-distance methodology.

REFERENCES

Aba-league. Retrieved March 2, 2016, from http://www.aba-liga.com/Home.aspx.

Aizemberg, L., Roboredo, M. C., Ramos, T. G., de Mello, J. C. C. S., Meza, L. A., & Alves, A. M. (2014). Measuring the NBA Teams" Cross-Efficiency by DEA Game. *American Journal of Operations Research*, *4*(03), 101.

Alves, L. A., Kramer, H. H., Tschaffon, P. B., & de Mello, J. S. (2013). Assessing efficiency and setting benchmarks for NBA teams through DEA and DMU clustering. In *Proceedings of the 4th International Conference on Mathematics in Sport*.

Anderson, M., Wolfson, S., Neave, N., Moss, M. (2012) Perspectives on the home advantage: A comparison of football players, fans and referees. *Psychological of Sport and Exercise* **13**, 311-316.,

Anderson, T. R. (2004). Benchmarking in Sports. In *Handbook on data envelopment analysis* (pp. 443-454). Springer US.

Banker, R. D., Charnes, A., & Cooper, W. W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis.*Management science*, *30*(9), 1078-1092.

Barros, C. P., & Santos, A. (2003). Productivity in sports organisational training activities: a DEA study. *European Sport Management Quarterly*,*3*(1), 46-65.

Bulajic, M., Savic, G., Savic, S., Mihailovic, N., & Martic, M. (2011). Efficiency assessment of banks in Serbia. *Technics Technologies Education Management-TTEM*, *6*(3), 657-662.

Celebi, M. E., Kingravi, H. A., & Vela, P. A. (2013). A comparative study of efficient initialization methods for the k-means clustering algorithm. *Expert Systems with Applications*, *40*(1), 200-210.

Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European journal of operational research*, *2*(6), 429-444.

Cooper, W. W., Ruiz, J. L., & Sirvent, I. (2009). Selecting non-zero weights to evaluate effectiveness of basketball players with DEA. *European journal of operational research*, *195*(2), 563-574.

De Mello, J. C. C. S., Angulo-Meza, L., & Da Silva, B. P. B. (2009). A ranking for the Olympic Games with unitary input DEA models. *IMA Journal of Management Mathematics*, *20*(2), 201-211.

Delibašić, B., Kirchner, K., Ruhland, J., Jovanović, M., & Vukićević, M. (2009). Reusable components for partitioning clustering algorithms. *Artificial Intelligence Review*, *32*(1-4), 59-75.

Delibašić, B., Vukićević, M., Jovanović, M., Kirchner, K., Ruhland, J., & Suknović, M. (2012). An architecture for component-based design of representative-based clustering algorithms. *Data & Knowledge Engineering*,*75*, 78-98.

Deza, M. M., & Deza, E. (2009). *Encyclopedia of distances* 1-583. Springer Berlin Heidelberg.

Economictimes. Retrieved April 7, 2016, from http://articles.economictimes.indiatimes.com/2011-04-03/news/30149956_1_higher-gdp-population-medals.

European National Baketball Ranking (ENBR). Retrieved March 2, 2016, from https://en.wikipedia.org/wiki/European_national_basketball_league_rankings#Current_league_rankings

Farrell, M. J. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society. Series A (General)*, *120*(3), 253-290.

Humphreys, B. R., Maresova, K., & Ruseski, J. E. (2012). *Institutional factors, sport policy, and individual sport participation: An international comparison* (No. 2012-1). University of Alberta, Department of Economics.

Jeremic, V., Bulajic, M., Martic, M., & Radojicic, Z. (2011). A fresh approach to evaluating the academic ranking of world universities. *Scientometrics, 87* (3), 587-596. doi:10.1007/s11192-011-0361-6

Jeremic, V., Bulajic, M., Martic, M., Markovic, A., Savic, G., Jeremic, D., et al. (2012). An Evaluation of European Countries" Health Systems through Distance Based Analysis. *Hippokratia, 16* (2), 170-174.

Labonté, R. (2016). From the Myth of Level Playing Fields to the Reality of a Finite Planet; Comment on'A Global Social Support System: What the International Community Could Learn from the United States" National Basketball Association's Scheme for Redistribution of New Talent'. *Int J Health Policy Manag*, *5*(2), 137-139.

Lera-López, F., Lizalde-Gil, E., Hallmann, K., & Petry, K. (2013). 12.2 Sport System and the Structure of Organized Sport. *Comparative Sport Development: Systems, Participation and Public Policy*, *8*, 149.

Lewis, H. F. (2014). Performance measurement of major league baseball teams using network DEA. In *Data Envelopment Analysis* 475-535. Springer US.

Ma, T. L., Wang, L., & Wang, D. (2014). Fuzzy C-Mean Clustering Image Segmentation Algorithm Research for MRI Sport Graphics Based on Genetic Algorithm. In *Applied Mechanics and Materials* . Vol. 513, 3711-3714.

Martić, M., Novaković, M., & Baggia, A. (2009). Data envelopment analysis-basic models and their Utilization. *Organizacija*, *42*(2), 37-43.

Moreno, P., & Lozano, S. (2014). A network DEA assessment of team efficiency in the NBA. *Annals of Operations Research*, *214*(1), 99-124.

Petrović Djordjević, D., Vujošević, M., & Martić, M. (2015). MEASURING EFFICIENCY OF FOOTBALL TEAMS BY MULTI-STAGE DEA MODEL.*Tehnicki vjesnik/Technical Gazette*, *22*(3).

Radojicic, M., Savic, G., Radovanovic, S., & Jeremic, V. (2015). A NOVEL BOOTSTRAP DBA-DEA APPROACH IN EVALUATING EFFICIENCY OF BANKS. *Scientific Bulletin" Mircea cel Batran" Naval Academy*, *18*(2), 375.

Radovanović, S., Radojičić, M., & Savić, G. (2014). Two-phased DEA-MLA approach for predicting efficiency of NBA players. *Yugoslav Journal of Operations Research ISSN: 0354-0243 EISSN: 2334-6043*, *24*(3).

Ramón, N., Ruiz, J. L., & Sirvent, I. (2012). Common sets of weights as summaries of DEA profiles of weights: with an application to the ranking of professional tennis players. *Expert Systems with Applications*, *39*(5), 4882-4889.

ReadingTree. Retrieved March 16, 2016, from http://www.readingtree.org/top-10-most-popular-sports-in-the-world/.

Ribeiro, C. C. (2012). Sports scheduling: Problems and applications.*International Transactions in Operational Research*, *19*(1-2), 201-226.

Ruiz, J. L., Pastor, D., & Pastor, J. T. (2013). Assessing professional tennis players using data envelopment analysis (DEA). *Journal of Sports Economics*, *14*(3), 276-302.

Savic, G., Makajic-Nikolic, D., & Suknovic, M. (2012). AHP-DEA Measure for study program selection. *Symorg* (pp. 1217-1223). Zlatibor: University of Belgrade, Faculty of Organizational Sciences.

Savic, G., Radosavljevic, M., & Ilijevski, D. (2013). DEA Window Analysis Approach for Measuring the Efficiency of Serbian Banks Based on Panel Data. *Management.* doi:10.7595/management.fon.2012.0028.

Tan, P. N., Steinbach, M., & Kumar, V. (2013). Data mining cluster analysis: Basic concepts and algorithms.

Tiedemann, T., Francksen, T., & Latacz-Lohmann, U. (2011). Assessing the performance of German Bundesliga football players: a non-parametric metafrontier approach. *Central European Journal of Operations Research,19*(4), 571-587.

Vazirgiannis, M., Halkidi, M., & Gunopulos, D. (2012). *Uncertainty handling and quality assessment in data mining*. Springer Science & Business Media.

Wang, J., Wang, J., Ke, Q., Zeng, G., & Li, S. (2015). Fast approximate k-means via cluster closures. In *Multimedia Data Mining and Analytics* 373-395. Springer International Publishing.

Wikipedia. Retrieved April 11, from https://en.wikipedia.org/wiki/2012%E2%80%9313_ABA_League.

Willoughby, Jack. (2014). Attendance, Home Advantage, and the Effect of a City on its Professional Sports Teams. Duke University Durham, North Carolina.

Yu, P., & Lee, J. H. (2013). A hybrid approach using two-level SOM and combined AHP rating and AHP/DEA-AR method for selecting optimal promising emerging technology. *Expert Systems with Applications*, *40*(1), 300-314.

APPLICATION OF GENETIC ALGORITHM IN AUTOMATED TRADING

Pavle Jovanović*[1], Aleksandar Rakićević[1], Bratislav Petrović[1]
[1]University of Belgrade, Faculty of organizational sciences
*Corresponding author, e-mail: pavlej93@gmail.com

Abstract: *This paper describes the use of genetic algorithm in the automated trading. Automated trading makes up a high percentage of the total trading volume which makes it very promising for future research. The proposed trading system is based on genetic algorithm which is here used to optimize parameters of a trading strategy in order to obtain the most profitable combination. The proposed trading strategy uses technical indicators to extract trading signals from market prices. Further, we use several performance measures to evaluate trading successfulness. The proposed trading system is tested in US stock market data.*

Keywords: *automated trading, genetic algorithm, optimization, stock market, technical indicators, trading strategy.*

1. INTRODUCTION

Automated trading (AT), also known as algorithmic trading, represents electronic trading in computerized manner, using computer programs and algorithms. Following development of information-communication technologies, AT raised as the new area of modern finance. In order to speed-up their reactions to new information and profit opportunities, market players started introducing algorithms in market trading at the end od 1980s and during 1990s. At the first time, these algorithms were meant to accelerate trading order execution, but with time the algorithms became more complex and intelligent. During the 2000s, AT has experienced extensive expansion in use and popularity. Kissel (2013) states that the total market volume made by automated trading systems raised from 25% in 2005 to almost 75% in 2009.

The main advantage of an automated trading system, if its trading algorithm is well written, is its speed. Today's market is very dynamic and unpredictable. Due to increasingly rapid changes in the market, it often happens that a man is not able to react to new information or profit opportunity in a timely manner, even if those are foreseen in advance. In order “to compete the market”, one needs to use some kind of computerized support. Computer algorithms have ability to react to a rapidly changing market conditions and execute transactions before another change occurs.

There are two main approaches to financial market analysis. Fundamental analysis (FA) relies on financial statement data, analyze company"s business performances. On the other side, technical analysis (TA) uses historical market data such as price, volume, bid, ask etc. to build technical indicators – models that attempt to mathematically and graphically describe the movement on the market. Many traders and other market participants use these indicators for trading and for building automated trading systems.

The first work in which the genetic algorithm (GA) was used to optimize a trading strategy was done by Allen and Karjalainen (1999). They used GA to learn technical trading rules for the S&P 500 index using daily prices from 1928 to 1995. Outside of training data (out-of-sample) their algorithm was not giving much of a good results, but it was very simple and its parameters were not necessarily optimized. Their work represented the basis for further research of many authors.

Deng *et al.* (2012) reported that trading profit is a discrete and multimodal function with many parameters and that therefore genetic algorithms and genetic programming may be used to optimize the trading rules in order to obtain profitable trading strategy. Their trading environment was currency market (FOREX). Their trading strategy was based on technical indicators, while the GA was used to optimize parameters of the strategy. Cheung and Kaymak (2007) were among those who tried to optimize fuzzy-rule-based trading strategy. They used GA to set the membership functions of fuzzy sets within the if-then rules in fuzzy inference system.

In this study a stock market trading strategy based on TA was created. We use three technical indicators to obtain buy/sell signals. Further, we apply GA to optimize input parameters for these indicators in order to discover set of parameters that will ensure the profitable outcome of stock market trading. We use profit factor as a performance measure of strategy successfulness. Profit factor is also used as a fitness function

for genetic algorithm. To test our model, we create virtual trading engine to simulate stock market trading. We use real data from American stock market.

The remainder of this paper is organized in four sections. In Section 2 we will give a theoretical basis of genetic algorithm. The proposed model is presented in Section 3. It gives necessary details about trading strategy and technical indicators being used to build it. In this section, we also explain the proposed mechanism for GA which is used to optimize trading strategy. In Section 4 we explain stock market data, experimental settings and performance measures used for testing the proposed model. Further, we present results and briefly discuss them. Finally, the paper is concluded with Section 5.

2. GENETIC ALGORITHM

Genetic algorithms (GAs) were invented by John Holland in the 1960s. Mitchell (1999) report that „ Holland's 1975 book *Adaptation in Natural and Artificial Systems* presented the genetic algorithm as an abstraction of biological evolution and gave a theoretical framework for adaptation under the GA. Holland's GA is a method for moving from one population of „chromosomes" (e.g., strings of ones and zeros, or „bits") to a new population by using a kind of „natural selection" together with the genetics−inspired operators of crossover, mutation, and inversion. Each chromosome consists of „genes" (e.g., bits), each gene being an instance of a particular „allele" (e.g., 0 or 1)." Accordingly we can say that GAs mimic the process of natural selection. Each individual in a population is characterized by a chromosome that represents its genetic code. Those individuals showing better adaptation (better fitness) in problem environment get the greater opportunity to reproduce themselves. This is the mechanism that allows "better genes" to spread across the population. For this reason, the new generation of individuals is better adapted from the previous one.

One of the main strengths of the GAs lie in the fact that they are able to determine the position of the global optimum in the area with several local extremes, in the so-called multimodal space. This is the reason why they are widely and extensively practiced for optimization purpose. However, as with other heuristics, there is no guarantee for optimal solution (global optimum).

There are three most important features, also known as genetic operators, which largely determine the success of a genetic algorithm. Those features are:

- reproduction (multiplication, crossover)
- mutations and
- selection.

The reproduction starts when two parents are selected to participate in the process. The most important characteristic of reproduction process is that the children inherit the properties of their parents. If the parents possess good genetic material then it is most likely that the child will posses good, if not better genetic material than the parents. Reproduction operator is binary and it can be defined as: uniform reproduction, reproduction with one breakpoint and reproduction with multiple breakpoints.

The mutation represents a random change of one or more alleles in a gene sequence. It is an unary operator, since it acts on one unit. The result of mutations is a changed unit. Mutation operator is very important since it helps GA to avoid local extremes and to restore lost genetic material.

The purpose of the selection process is the preservation and transfer of good traits to the next generation of units. It imitates the famous mechanism of "natural selection". The selection is used to choose best fitted units in a current population to enable them to participate in reproduction process. In this way the good genetic material is given opportunity to spread in next generation, while the bad material is rejected. However, continuous selection of the most fitted units and discarding others (so called elitism strategy) will lead to premature convergence of genes in a population. This effect usually ends with GA stucked in local optimum.

3. THE PROPOSED MODEL

The proposed model is consisted of input parameters, trading strategy and GA. In the following parts of this section we will give detail explanation of these components.

3.1. Technical indicators

In the following Table 1 we give details about technical indicators used for our trading strategy. These indicators are used to explain underlying model of a market and to signal trading opportunities for our trading system.

Table 1: Technical indicators

Indicator	Formula	Description
MACD line	$MACD(N,M) = EMA(N) - EMA(M)$	Moving Average Convergence/Divergence line tracks a difference between longer and shorter trend of the price
ROC	$ROC(N) = \frac{Price_t - Price_{(t-N)}}{Price_{(t-N)}} \cdot 100$	Rate of Change is designed to show the relative difference between today's closing price and the close N days ago
PSAR	$SAR_{(i)} = SAR_{(i-1)} + \alpha \cdot (ExtrimePrice - SAR_{(i-1)})$	Parabolic stop and reversal try to determine the end of current trend.

3.2. Strategy

Input parameters for the strategy are as follows:

- Input data are daily data consisted of opening, highest, lowest and closing prices.
- The initial trading account value
- Stop-loss and take-profit parameters
- Input parameters of previously explained technical indicators

When strategy is activated it first calculates indicator values for input price data using parameters provided with GA. Further, the strategy monitors indicators" values in order to check whether the trading conditions are met. If conditions are met, the strategy further checks if the position is already opened by the system or not. The strategy is written so that at one point it cannot manage more than one opened position. When position is finally opened, than the stop-loss and take-profit orders are set as closing conditions. Take-profit order is a trading order type that allows one to close out a profitable trade at a pre-determined price. On the other side, a stop-loss order is a protective order that closes out a losing position at some pre-determined price. When position is opened, the system monitors market price and if the price hits level of either one of these two orders, system closes position. When position is closed system recalculates account balance along with performance measures.

3.3. Model of genetic algorithm

The goal of this study is to apply GA to optimize trading strategy for automated trading. To optimize trading strategy we use profit factor as criteria function. Profit factor is a ratio of trading profits and losses. It is a discrete and multimodal but unknown function of many parameters. For this reason, GA represents an adequate tool for solving this problem. Since our trading model is based on technical indicators, the profit factor will be a function of indicators parameters.

The model of GA is probably the most important piece of work. Figure 1 shows the proposed model of GA used to optimize the proposed trading strategy.

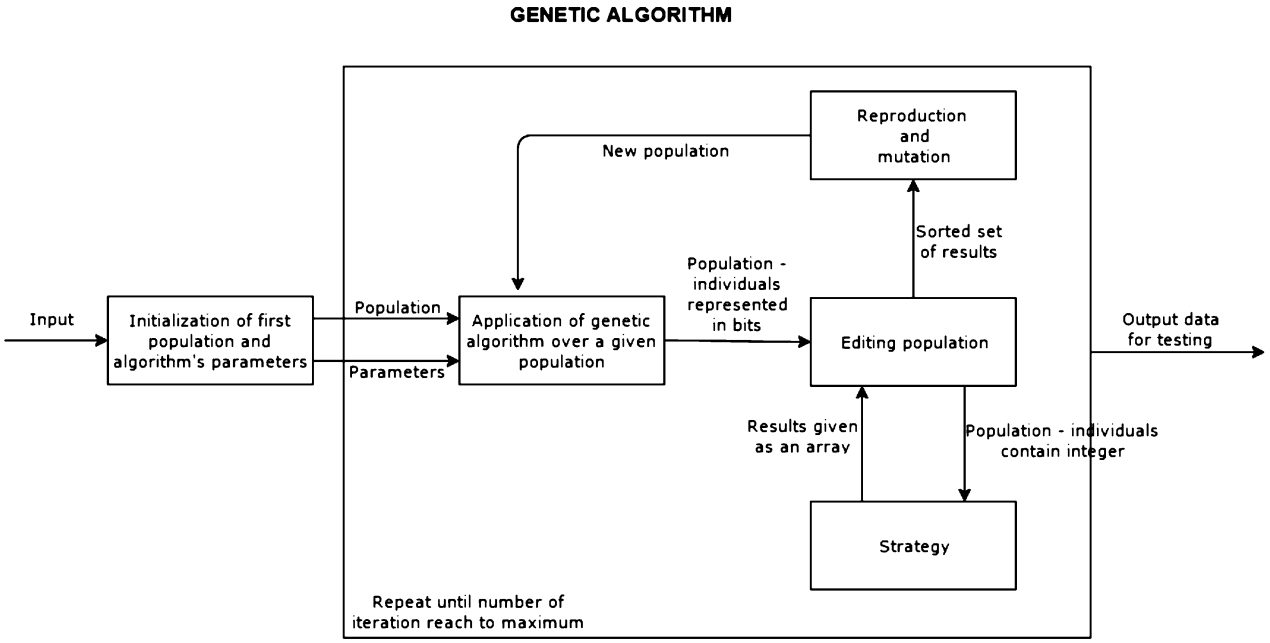


Figure 1: Model of the described genetic algorithm

In this study, we use binary representation to code genes in our GA. Consequently, genetic operators are also binary. One individual is represented with genetic sequence consisted of 5 genes and total of 27 alleles. Population is consisted of 64 individuals. Initial population is created randomly. Further, the selection procedure is such to retain certain percentage of the best individuals in population. The rest of population enters the reproduction process and creates children that will replace their parents in a new population. It is important to be noted that the better individual is fitted the greater chance for reproduction is assigned to it. In order to achieve this, we rank the rest of population by fitness and then split it in three parts. The first third of individuals is then duplicated before entering the reproduction pool. In that way we increase probability for their selection. We use multiple breakpoints as reproduction operator, which takes alleles alternately from both parents. The mutation is performed by random selection of alleles to be mutated. The number od alleles to be mutated (from 1 to 9) and their position in gene sequence (from 1 to 27) are determined randomly. Therefore, the mutation rate is not fixed but it changes through generations.

Our genetic code is consisted of 27 alleles which are used to represent 5 genes. Each gene represents one parameter in one of the three selected indicators. Parameters are coded in the following way:

- The first gene represents time window parameter of fast exponential moving average (EMA) within MACD indicator. It is coded as binary sequence consisted of 4 alleles which represent, when converted to integers, values between 0 and 15.
- The second gene is time window parameter of slow EMA within MACD indicator. It is coded with binary sequence of 5 alleles representing integer values between 0 and 31.
- The third gene is a binary sequence consisted of 5 alleles, representing time window in ROC indicator with values between 0 and 31.
- Fourth gene is a take-profit parameter described with a binary sequence of 7 alleles, representing integer values between 0 and 127.
- Finally, the fifth gene is a stop-loss parameter. It is a binary sequence of 6 alleles representing integer values between 0 and 63.

Evaluation of individuals is done in the following manner. Each individual is a set of parameters that are incorporated in trading strategy and tested against stock market data to obtain profit factor. The profit factor is adopted as a fitness function. Each individual is evaluated within population, while the process is repeated for each generation.

4. EXPERIMENTAL RESULTS

In this chapter we will present test data, experimental settings, performance measures and experimental results with the corresponding discussion.

4.1. Data

The data used in this experiment is a real US stock market data. We focus on two companies: Microsoft corporation (MSFT) and Nike Inc. (NKE). The data includes price series from 1 January 1994 to 31 December 2013. Data is separated in two samples: training data (in-sample) and test data (out-of-sample).

Table 2: *Microsoft data*

Date	Open	High	Low	Close
3.1.1994	2,52	2,52	2,48	2,51
4.1.1994	2,51	2,52	2,48	2,52
...	...	...	...	...
11.5.2000	33,31	24,06	32,88	33,94
12.5.2000	34,22	34,88	34,12	34,41
...	...	...	...	...
4.1.2007	29,7	29,97	29,44	29,81
5.1.2007	29,63	29,75	29,45	29,64
....	....	...	...	...
30.12.2013	37,22	37,38	36,9	37,29
31.12.2013	37,4	37,58	37,22	37,41

In Table 2 we present the structure of data. Data contains daily prices of shares including:

- price at the beginning of the trading day (open price)
- price at the end of the trading day (close price)
- the highest price for the trading day (high price)
- the lowest price for the trading day (low price)

4.2. Experimental settings

Here, we present the basic experimental settings of our model. The values of parameters used in the algorithm:

- Initial trading funds are 100.000 monetary units,
- Maximum number of iterations is 200 (which means GA will have 200 generations),
- Maximum population size is 64,
- Number of parents that are transferred to a new generation is 8 (12,5%),
- Number of children obtained is 56
- The number of alleles that will mutate in a selected individual is a random number between 1 and 9,
- Trading commission is accounted for 3%

4.3. Performance measures

The following measures are used to evaluate trading strategy performances:

- **Profit factor –** the ratio of total gains and total losses made by the strategy

$$Profit\ Factor = \frac{Total\ Gains}{Total\ Losses}; \tag{1}$$

- **Drawdown –** the biggest drop in trading funds relatively to the maximum achieved level;
- **Profit –** total net earnings made by the strategy; difference between final and initial size of trading funds.

4.4. Results and discussion

Having in mind the structure of genetic operators and the fact that initial population is chosen randomly, it is obvious that each new startup of our model will give different final solution. However, the solutions vary a little which indicates the obtained final solutions are relatively stable. In the following Tables 3, 4 and 5, we present results for best individuals (parameter combinations) obtained for MSFT in training period from 1 January 1994 to 31 December 2006.

Table 3: Best 5 individuals in training results for the first generation

Profit factor	Profit	Drawdown	Number of transaction	Short	Long	Roc period	Take profit	Stop loss
2,41	158,81%	-62,74%	13	3	13	10	13%	25%
1,26	51,33%	-72,52%	11	3	24	24	112%	21%
1,02	6,94%	-87,25%	14	13	20	22	47%	22%
0,94	-13,44%	-84,57%	11	4	19	27	64%	22%
0,89	-33,41%	-90,83%	14	14	27	16	114%	23%

Table 4: Best 3 individuals in training results for the 100th generation

Profit factor	Profit	Drawdown	Number of transaction	Short	Long	Roc period	Take profit	Stop loss
144.584,81	144,58%	-66,51%	14	11	30	14	5%	44%
144.584,81	144,58%	-66,51%	14	11	30	14	5%	46%
137.699,97	137,7%	-62,84%	14	11	12	12	5%	44%

Table 5: Best 3 individuals in training results for the 200th generation

Profit factor	Profit	Drawdown	Number of transaction	Short	Long	Roc period	Take profit	Stop loss
356.839,98	356,84%	-61,62%	10	10	30	10	15%	58%
322.377,43	322,37%	-61,62%	10	10	30	10	14%	60%
248.681	248,68%	-58,69%	18	10	30	10	6%	28%

As we can see in Table 3, there are only three profitable combinations of parameters in the initial population. Results for 100th generation shows that population contains 14 individual that are evaluated almost without losses. From the best three ones that are shown in Table 4, we can conclude that parameters begin to converge to certain values. This mean they are located in the vicinity of an optimum (local or global). In Table 5 we present results for the last 200th generation. Individuals in this generation are even more successful (with higher profit factor) than those in 100th generation.

Optimization of strategy using genetic algorithm took 2.348 seconds or a little less than 40 minutes. Compared to, for example, sequential optimizations, it takes much less time and the obtained final solutions are good enough. It is worth mentioning that the profit factor of the best strategy obtained by using genetic algorithm optimization is not much lower than the one obtained by sequential optimization. For this reason the time aspect is crucial. In order to react adequately and fast enough to changes in the market the data should be processed as quickly as possible. This information shows the importance and potential of using genetic algorithm to optimize trading strategies.

Tables 6 and 7 indicate the test results of the best strategies for MSFT and NKE in the period from 3 January 2007 to 31 December 2013.

Table 6: Test results for the best 3 individuals in training set (MSFT)

Profit factor	Profit	Drawdown	Number of transaction	Short	Long	Roc period	Take profit	Stop loss
53.415,46	53,42%	-62,59%	3	10	30	10	15%	58%
73.114,59	73,11%	-62,59%	4	10	30	10	14%	60%
0,84	-6,11%	-66,58%	6	10	30	10	6%	28%

Table 7: Test results for the best 3 individuals in training set (NKE)

Profit factor	Profit	Drawdown	Number of transaction	Short	Long	Roc period	Take profit	Stop loss
53.286,44	53,29%	-70,13%	3	10	30	10	15%	58%
1,52	17,92%	-50,21%	9	10	30	10	14%	60%
0,419	-34,71%	-68,74%	8	10	30	10	6%	28%

As can be seen from these tables, the first two strategies tested on the MSFT data operated positively. However, the gains were reduced. Contrary to the first two, test simulation of the third strategy shows negative profitability. The similar is with NKE data, though it should be noted that the second strategy has seen a big drop in profitability even though it remains positive. The reason for the fall in profitability of these strategies can be found in the fact the year of great economic crises in 2008 was covered by the test data sample. Such market behavior was not seen before that in train data which is the possible reason why the best fitted individuals in training experienced big drop in performance in test. The way in which this could be

overcome is to monitor the accounts and to stop the algorithm when losses hit a certain percentage of the maximum resources available, and then to have it re-learn from the new dataset including this period. This is one of the ideas for the future extensions of this study.

4. CONCLUSION

This paper describes stock market trading using genetic algorithm to optimize trading strategy parameters. The strategy employs technical indicators to obtain trading signals. The task of genetic algorithm is to optimize the parameters of technical indicators in order to find the most profitable trading strategy.

On the basis of results obtained in this paper, we can conclude that the genetic algorithm was successful in finding a strategy that will operate positively. We also conclude that one cannot absolutely rely on trading using the proposed algorithm, since the final solutions experience big drop in performances during test period. Further, the number of profitable trading strategies is not great. However, a good knowledge of financial instruments and properly written algorithm may lead to the creation of profitable trading strategies. Generally, the use of algorithms for trading on the stock market represents the future of automated trading. As automated trading makes up over 50% of the total trading on the stock exchange, we conclude that the application of genetic algorithm trading can be very useful and that it has a promising future.

Possible future directions of work on this topic may relate toward increasing the number of indicators used in the strategy and introducing fuzzy or some kind of multi-valued logic to model trading rules.

REFERENCES

Cheung, W. M., & Kaymak, U. (2007). A fuzzy logic based trading system. *Proceedings of the Third European Symposium on Nature-inspired Smart Information Systems* (Vol. 59).

Colby, R. W., & Meyers, T. A. (1988). *The encyclopedia of technical market indicators*. New York: Irwin.

Franklin A., & Karjalainen, R. (1999). Using genetic algorithms to find technical trading rules. *Journal of Financial Economics*, 51(2), 245-271. doi:10.1016/S0304-405X(98)00052-X

Kim, K. (2010). *Electronic and algorithmic trading technology: the complete guide*. Academic Press.

Kissell, R. (2013). *The science of algorithmic trading and portfolio management*. Academic Press.

Leshik, E. A., & Cralle, J. (2011). *An Introduction to Algorithmic Trading*. Padstow: John Wiley and Sons.

Mitchell, M. (1998). *An introduction to genetic algorithms*. MIT press. Cambridge, Massachusetts., England: London

Ozturk, M., Toroslu, I. H., & Fidan, G. (2016). Heuristic based trading system on Forex data using technical indicator rules. *Applied Soft Computing*, *43*, 170-186. doi:10.1016/j.asoc.2016.01.048

Papadamou, S., & Stephanides, G. (2007). Improving technical trading systems by using a new MATLAB-based genetic algorithm procedure. *Mathematical and computer modelling*, *46*(1), 189-197. doi:10.1016/j.mcm.2006.12.033

Shangkun, D., Yizhou, S., & Akito, S. (2012). Robustness test of genetic algorithm on generating rules for currency trading. *Procedia Computer Science*,*13*, 86-98. doi:10.1016/j.procs.2012.09.117

Straßburg, J., Gonzàlez-Martel, C., & Alexandrov, V. (2012). Parallel genetic algorithms for stock market trading rules. *Procedia Computer Science*, *9*, 1306-1313. doi:10.1016/j.procs.2012.04.143

ON A PARAMETRIC APPROACH TO IMPROVE THE SOLUTION TO A FUZZY BI-CRITERIA TRANSPORTATION PROBLEM

Bogdana Stanojević[1], Milan Stanojević*[2]
[1]Mathematical Institute of the Serbian Academy of Sciences and Arts
[2]Faculty of Organizational Sciences, University of Belgrade
*Corresponding author, e-mail: milans@fon.bg.ac.rs

Abstract: *Keshavarz and Khorram (2011) developed a new approach to solve a fuzzy bi-criteria transportation problem, based on parametric linear programming. They stated four fuzzy goals, used the general non-linear programming model suggested by Bellman and Zadeh (1970) to aggregate them, and derived and solved two bi-level optimization problems. In this paper we propose an improved approach, such that the obtained solution reaches the highest level of satisfaction of the stated fuzzy goals. We recall an illustrative example to show the effectiveness of the new methodology.*

Keywords*: fuzzy programming, bi-criteria transportation, fuzzy interval, bi-level programming, parametric programming*

1. INTRODUCTION

The classical transportation problem is a particular case of a linear programming problem. Due to its particularity, the transportation problem is commonly solved using efficient specific algorithms, for instance simplified versions of the simplex technique. Despite the fact that the transportation problem is very old, nowadays researchers continue to pay attention to it. In the recent literature many heuristics are proposed to solve large-scale transportation problems. Also, generalized models involving fuzzy or stochastic quantities are introduced and discussed (see for instance Keshavarz and Khorram, (2011), Kundu et al. (2015), Li et al. (2014), Ojha et al. (2014), Sabbagh et al. (2015), Sterzik and Kopfer (2013), Wang et al. (2014)).

Kocken and Sivri (2015) proposed a new method to generate all optimal solutions to a fully fuzzy version of the solid transportation problem, i.e. a solid transportation problem with fuzzy costs coefficients, fuzzy supply, fuzzy demand, and fuzzy conveyance. They developed auxiliary programs to construct the parametric form of the solutions. Kaur and Kumar (2012) proposed a new algorithm for solving a special type of fuzzy transportation problems. They assumed that a decision maker is uncertain about the precise values of the transportation cost, but he is certain about the supply and demand of the product. They considered the uncertain quantities expressed by generalized trapezoidal fuzzy numbers; and developed their approach as direct extension of the classical one.

Ebrahimnejad (2014), by choosing a ranking function for the Kaur and Kumar's method to solve the fuzzy transportation problem, converted the original problem into a crisp one, thus reducing the computational complexity of the solving method. Keshavarz and Khorram (2011) solved a fuzzy bi-objective transportation problem using Bellman-Zadeh principle for aggregating the objective functions and the fuzzy goals. We address the same problem, and involve decisively the Pareto optimality concept in the solving approach.

The paper is organized as follows. In Section 2 we set up notation and terminology related to the fuzzy bi-criteria transportation problem (FBCTP). In Section 3 we briefly sketch the approach introduced by Keshavarz and Khorram (2011) to solving the FBCTP. In Section 4 we introduce an extended solving method, while in Section 5, we recall Example 2 from (Keshavarz and Khorram (2011) to illustrate the effectiveness of the new method. Section 6 provides the final remarks and suggests directions for the further research.

2. PROBLEM FORMULATION

In this section we present the general bi-criteria balanced transportation problem introduced by Keshavarz and Khorram (2011). The problem has *m* supply nodes and *n* destination nodes. Let S_i, $i=\overline{1,m}$, and D_j,

$j=\overline{1,n}$ denote the quantities that are supplied by the source node *i*, and the quantities that are required by the destination node *j*, respectively.

Let t_{ij} and p_{ij}, $i=\overline{1,m}$, $j=\overline{1,n}$ be the coefficients of the objective functions. Let x_{ij}, $i=\overline{1,m}$, $j=\overline{1,n}$ be the number of units transferred along the link (i,j). The problem is to determine a feasible way of transporting the available amount of commodities from sources to destinations, such that it minimizes the first objective function and maximizes the second one. The mathematical formulation of the general bi-criteria balanced (i.e. $\sum_{i=1}^{m} S_i = \sum_{j=1}^{n} D_j$) transportation problem is given by (1).

$$\begin{aligned}
&\min \quad \sum_{i=1}^{m}\sum_{j=1}^{n} t_{ij}x_{ij},\\
&\max \quad \sum_{i=1}^{m}\sum_{j=1}^{n} p_{ij}x_{ij},\\
&\text{s.t.} \quad \sum_{j=1}^{n} x_{ij} = S_i, \qquad i=\overline{1,m},\\
&\qquad \sum_{i=1}^{m} x_{ij} = D_j, \qquad j=\overline{1,n},\\
&\qquad x_{ij} \geq 0, \qquad i=\overline{1,m}, \quad j=\overline{1,n}.
\end{aligned} \tag{1}$$

For the FBCTP in (Keshavarz and Khorram (2011)), the coefficients t_{ij} and p_{ij}, $i=\overline{1,m}$, $j=\overline{1,n}$ were defined as fuzzy intervals, while the supply and demand quantities were exact numbers. For their problem, the desired solution must be a good compromise between four fuzzy goals defined as follows:

- given the coefficients α_{ij} and β_{ij}, the membership function of the first goal, on the link (i,j), is defined by

$$\mu_{ij}^{1}(t_{ij}) = \begin{cases} 1, & t_{ij} \geq \beta_{ij}, \\ (t_{ij}-\alpha_{ij})/(\beta_{ij}-\alpha_{ij}), & \alpha_{ij} < t_{ij} < \beta_{ij}, \\ 0, & \text{otherwise}, \end{cases} \tag{2}$$

- the membership function of the second goal is defined by

$$\mu^{2}(T(x)) = \begin{cases} 1, & T(x) \leq \alpha, \\ (\beta - T(x))/(\beta-\alpha), & \alpha < T(x) < \beta, \\ 0, & \text{otherwise}, \end{cases} \tag{3}$$

  where $T(x) = \sum_{i=1}^{m}\sum_{j=1}^{n} t_{ij}x_{ij}$, $\alpha = \min_{x\in X} \sum_{i=1}^{m}\sum_{j=1}^{n} \alpha_{ij}x_{ij}$, and $\beta = \max_{x\in X} \sum_{i=1}^{m}\sum_{j=1}^{n} \beta_{ij}x_{ij}$ (note that the second goal is inverse related to the first one, through the coefficients α_{ij} and β_{ij} used in defining both of them);
- given the coefficients a_{ij} and b_{ij}, the membership function of the third goal, related to the transportation on the link (i,j), is defined by

$$\mu_{ij}^{3}(p_{ij}) = \begin{cases} 1, & p_{ij} \leq a_{ij}, \\ (b_{ij}-p_{ij})/(b_{ij}-a_{ij}), & a_{ij} < T(x) < b_{ij}, \\ 0, & \text{otherwise}, \end{cases} \tag{4}$$

- the membership function of the fourth goal is defined by

$$\mu^{4}(P(x)) = \begin{cases} 1, & P(x) \geq b, \\ (P(x)-a)/(b-a), & a < P(x) < b, \\ 0, & \text{otherwise}, \end{cases} \tag{5}$$

where $P(x)=\sum_{i=1}^{m}\sum_{j=1}^{n} p_{ij}x_{ij}$, $a=\min_{x\in X}\sum_{i=1}^{m}\sum_{j=1}^{n} a_{ij}x_{ij}$, and $b=\max_{x\in X}\sum_{i=1}^{m}\sum_{j=1}^{n} b_{ij}x_{ij}$ (note that the forth goal is inverse related to the third one, through the coefficients a_{ij} and b_{ij} used in defining both of them).

3. KESHAVARZ AND KHORRAM'S SOLVING APPROACH

In this section we briefly present Keshavarz and Khorram's (2011) solving approach.

Keshavarz and Khorram (2011) chose the Bellman-Zadeh principle to solve the FBCTP. More precisely, the membership functions of the fuzzy goals of the FBCTP were aggregated using the max-min operator, as shown in (6).

$$\max_{x\in X}\left\{\min\left\{\min_{(i,j)\mid x_{ij}\neq 0}\left(\mu_{ij}^{1}(t_{ij})\right),\min_{(i,j)\mid x_{ij}\neq 0}\left(\mu_{ij}^{3}(p_{ij})\right),\mu^{2}(T(x)),\mu^{4}(P(x))\right\}\right\}, \tag{6}$$

where μ_{ij}^{1}, μ^{2}, μ_{ij}^{3}, and μ^{4} are defined by (2), (3), (4), and (5), respectively; and X is the feasible set of Problem (1). More precisely, for each $x\in X$, only those membership functions μ_{ij}^{1} and μ_{ij}^{3} that have indexes (i,j) such that $x_{ij}\neq 0$ were considered in (6).

Since the max-min problem (6) is generally nonlinear, Keshavarz and Khorram (2011) proposed a way to simplify it for the particular case of a FBCTP. They first formulated a bi-level problem with two parametric objective functions in the lower level (Model (23) in Keshavarz and Khorram (2011)); and announced that the optimal transportation assignment should be a Pareto optimal solution to the lower level problem.

Further, they proceeded to solve separately two bi-level problems, namely (7) and (8)

$$\begin{aligned}&\max \quad \lambda\\ &\text{s.t.} \quad \mathrm{f}(\lambda,\bar{\mathrm{x}})\le 0,\ g(\lambda,\bar{x})\le 0,\ \mathrm{f}(\lambda,\bar{\mathrm{x}})\cdot g(\lambda,\bar{x})=0\\ &\qquad \bar{x}\in \arg\min\left\{\sum_{i=1}^{m}\sum_{j=1}^{n}\left(\alpha_{ij}+(\beta_{ij}-\alpha_{ij})\lambda\right)x_{ij}\mid x\in X\right\}\end{aligned} \tag{7}$$

$$\begin{aligned}&\max \quad \lambda\\ &\text{s.t.} \quad \mathrm{f}(\lambda,\bar{\mathrm{x}})\le 0,\ g(\lambda,\bar{x})\le 0,\ \mathrm{f}(\lambda,\bar{\mathrm{x}})\cdot g(\lambda,\bar{x})=0\\ &\qquad \bar{x}\in \arg\min\left\{\sum_{i=1}^{m}\sum_{j=1}^{n}\left(b_{ij}-(b_{ij}-a_{ij})\lambda\right)x_{ij}\mid x\in X\right\}\end{aligned} \tag{8}$$

where

$$f(\lambda,x)=\lambda-\frac{\beta-\sum_{(i,j)\mid x_{ij}\neq 0}\left(\alpha_{ij}+(\beta_{ij}-\alpha_{ij})\lambda\right)x_{ij}}{\beta-\alpha},\quad g(\lambda,x)=\lambda-\frac{\sum_{(i,j)\mid x_{ij}\neq 0}\left(b_{ij}-(b_{ij}-a_{ij})\lambda\right)x_{ij}-a}{b-a}. \tag{9}$$

Finally, they compared the two solutions, and chose as final solution the one with the maximal value of λ.

Note that Keshavarz and Khorram solved two bi-level problems instead of the original bi-level problem with a bi-objective function on lower level; and obtained a Pareto optimal solution to the original bi-objective problem, but not that solution that defines the transportation assignment with the highest level of satisfaction of all four fuzzy goals. An improved solution, with respect to the satisfaction level of the original fuzzy goals, may be obtained by analyzing the entire set of Pareto optimal basic solutions. The extended method presented in Section 4 supports this statement. The numerical example presented in Section 5 illustrates it.

4. THE EXTENDED SOLVING METHOD

Our extended method decisively relays on the efficient set of the parametric bi-objective optimization problem

$$
\begin{aligned}
\min \quad & \sum_{i=1}^{m}\sum_{j=1}^{n}\left(\alpha_{ij}+\left(\beta_{ij}-\alpha_{ij}\right)\lambda\right)x_{ij} \\
\max \quad & \sum_{i=1}^{m}\sum_{j=1}^{n}\left(b_{ij}-\left(b_{ij}-a_{ij}\right)\lambda\right)x_{ij} \\
\text{s.t.} \quad & \sum_{i=1}^{m} x_{ij} = D_j, \quad j=\overline{1,n} \\
& \sum_{j=1}^{n} x_{ij} = S_i, \quad i=\overline{1,m} \\
& x_{ij} \geq 0, \quad i=\overline{1,m}, \quad j=\overline{1,n}
\end{aligned}
\tag{10}
$$

In order to solve Problem (10), we combine a parametric linear programming analysis with a bi-objective simplex method, and find all basic feasible solutions that are efficient solutions for at least one value of $\lambda \in [0,1]$.

A parametric simplex algorithm for bi-objective linear programs can be found in Ehrgott (2005). This algorithm aggregates the two objective functions using a parameter $w \in (0,1)$, and provides a sequence of efficient basic feasible solutions to the bi-objective problem. For a bi-objective problem with coefficients depending on a parameter λ, in addition, we apply an efficiency test (for instance Benson's method, see Benson (1978)) to each basic feasible solution to determine whether it is efficient or not, and, if it is efficient, to find for which values of the parameter λ it remains efficient.

In what follows we propose a general method – Algorithm 4.1 – to find the efficient basic feasible solutions to the parametric bi-objective linear programming problem (10).

Algorithm 4.1.

- **Step 1.** Set $h \leftarrow 0$, and $\lambda^h \leftarrow 0$.
- **Step 2.** While $\lambda^h < 1$ do
  - solve Problem (10) with $\lambda \leftarrow \lambda^h$, using the parametric simplex algorithm (Ehrgott (2005)), and obtain the set of all efficient basic feasible solutions X_{eff}^h;
  - for each $x \in X_{eff}^h$, using the efficiency test (Benson (1978)) find the maximal interval $[\lambda^h, \lambda_x]$ such that *x* is efficient solution to (10) for every $\lambda \in [\lambda^h, \lambda_x]$;
  - compute $\lambda_{\min} = \min\{\lambda_x \mid x \in X_{eff}^h\}$;
  - set $h \leftarrow h+1$;
  - if $\lambda_{\min} \geq 1$, then set $\lambda^h \leftarrow 1$ otherwise $\lambda^h \leftarrow \lambda_{\min}$;

  end-while.
- **Step 3.** Set $s \leftarrow h$.

Algorithm 4.1 provides a sequence of sets X_{eff}^r, $r=\overline{0,s-1}$ together with a sequence of intervals $[\lambda^r, \lambda^{r+1}]$, $r=\overline{0,s-1}$.

Further, we construct

$$
X_{eff} = \bigcup_{r=0}^{s-1} X_{eff}^r , \tag{11}
$$

and for each $x \in X_{eff}$ we derive the set

$$
\Lambda_x = \bigcup_{r \in \{h \mid 0 \leq h < s, x \in X_{eff}^h\}} [\lambda^r, \lambda^{r+1}] \tag{12}
$$

Algorithm 4.2 solves Problem (6); thus finding the transportation assignment with the highest λ-level of satisfaction of all four original fuzzy goals. It uses Algorithm 4.1 to solve the problem on the lower level. The steps of Algorithm 4.2 are summarized below.

Algorithm 4.2.

- **Step 1.** Find all sets X_{eff}^{r}, and the corresponding intervals $\left[\lambda^{r},\lambda^{r+1}\right], r=\overline{0,s-1}$ that solve the bi-objective problem (10) using Algorithm 4.1.
- **Step 2.** Construct X_{eff} and Λ_x, $x \in X_{eff}$ using (11) and (12), respectively.
- **Step 3.** For each $x \in X_{eff}$
  - find λ_x^f, the unique solution to $f(\lambda,x)=0$, *f* defined by (9);
  - find λ_x^g, the unique solution to $g(\lambda,x)=0$, *g* defined by (9);
  - compute $\lambda_x=\min\left\{\lambda_x^f,\lambda_x^g\right\}$. If $\lambda_x \notin \Lambda_x$, then remove *x* from X_{eff}^{r}.
- **Step 4.** Find $\lambda^*=\max\left\{\lambda_x \mid x \in X_{eff}\right\}$ and x^* such that $\lambda^*=\lambda_{x^*}$.

5. NUMERICAL RESULTS

In this section, we recall the numerical example from (Keshavarz and Khorram, 2011), and use it to show that our extended solving method yields a solution that is better than Keshavarz and Khorram's solution, from the point of view of the λ-level of satisfaction of all four original fuzzy goals.

Practically, we solve the FBCTP with parameters given in Table 1. The intervals that describe the fuzzy coefficients of the criteria are given as pairs $<\alpha_{ij},\beta_{ij}>/<a_{ij},b_{ij}>$, $i=\overline{1,3}, j=\overline{1,4}$.

Table 1: Fuzzy intervals $<\alpha_{ij},\beta_{ij}>/<a_{ij},b_{ij}>$ for the coefficients t_{ij} and p_{ij}, $i=\overline{1,3}$, $j=\overline{1,4}$,

	***j*=1**	***j*=2**	***j*=3**	***j*=4**	**Supply**
i=1	<5,10>/<2,7>	<4,9>/<3,8>	<5,8>/<6,9>	<6,7>/<3,5>	10
i=2	<3,9>/<8,11>	<3,6>/<7,9>	<6,10>/<6,12>	<6,15>/<4,10>	20
i=3	<2,12>/<7,12>	<5,10>/<5,11>	<7,9>/<7,7>	<8,10>/<3,4>	40
Demand	20	10	15	25	

The left and right endpoints of the intervals for defining the second and the forth goals, computed by Keshavarz and Khorram, are α =335, β =815, a =310, and b =695 respectively.

Following the extended methodology, we generated all basic feasible solutions $\overline{x^k}$, $k=\overline{1,6}$, that are efficient solutions to the parametric Problem (10) for at least one value of λ, hence handling the compromise among the second and forth goals. For each solution $\overline{x^k}$ we computed the λ-level of the satisfaction of the first and third goals, (λ_f^k and λ_g^k, respectively), and derived $\lambda_{\min}^k$ as $\min\left\{\lambda_f^k,\lambda_g^k\right\}$ (see Table 2). As final solution, we chose the solution $\overline{x^k}$ with the greatest value of $\lambda_{\min}^k$.

Our optimal solution is $\overline{x^3}$ =(0,0,0,10,0,5,0,15,20,5,15,0) with the corresponding $\lambda_{\min}^k$ =0.5275591.

Table 2: The efficient basic feasible solutions

k	$\overline{x^k}$	λ_f^k	λ_g^k	$\lambda_{\min}^k$	$T\left(\lambda_{\min}^k,\overline{x^k}\right)$	$P\left(\lambda_{\min}^k,\overline{x^k}\right)$
1	(0,0,5,5,0,0,0,20,20,10,10,0)	0.5052632	0.5507246	0.5052632	572.47368	535.8947
2	(0,0,0,10,0,0,5,15,20,10,10,0)	0.5191257	0.5401460	0.5191257	565.81967	524.2623
3	(0,0,0,10,0,5,0,15,20,5,15,0)	0.5363128	0.5275591	0.5275591	553.93701	513.1102
4	(0,0,0,10,0,10,0,10,20,0,15,5)	0.5647059	0.5	0.5	520	502.5
5	(0,0,0,10,0,10,10,0,20,0,5,15)	0.5875	0.475	0.475	497	492.875
6	(0,0,0,10,10,10,0,0,10,0,15,15)	0.6081081	0.4326923	0.4326923	477.5	476.5865

Optimizing the objective functions distinctly, Keshavarz and Khorram obtained only two Pareto optimal solutions to Problem (10), the marginal ones, $\overline{x^1}$ and $\overline{x^2}$ in Table 2. For each of these two solutions, they computed the λ-level of the satisfaction of the original fuzzy goals, and chose the solution with the greatest value of λ. Their maximal λ =0.5052632 was obtained for $\overline{x^1}$ =(0,0,5,5,0,0,0,20,20,10,10,0).

The values of the objective functions for each Pareto optimal solution $\overline{x^k}$, $k=\overline{1,6}$, are also given in Table 2. Comparing our solution to the solution of Keshavarz and Khorram we found $T\left(\lambda^3_{\min},\overline{x^3}\right)<T\left(\lambda^1_{\min},\overline{x^1}\right)$ and $P\left(\lambda^3_{\min},\overline{x^3}\right)<P\left(\lambda^1_{\min},\overline{x^1}\right)$. The value of the first objective function at our solution is better (smaller) than the old one, while the value of the second objective at our solution is worse (smaller) than the old one. Both transportation assignments $\overline{x^1}$ and $\overline{x^3}$ are efficient solutions from the point of view of the original objective functions, thus they cannot be compared without looking to an additional attribute. Since the additional attribute for the FBCTP is the λ-level of the satisfaction of the original fuzzy goals, we conclude that our solution $\overline{x^3}$ to the transportation problem is better than the one proposed by Keshavarz and Khorram (2011).

6. CONCLUSIONS

In this paper we addressed the FBCTP introduced by Keshavarz and Khorram (2011). Keshavarz and Khorram solved the FBCTP via Bellman-Zadeh principle and desired to obtain the highest level of satisfaction of four original fuzzy goals.

In order to solve the FBCTP, we involved the Pareto optimality concept in our solving approach; and developed an algorithm that chooses, among the basic feasible Pareto optimal solutions to a parametric bi-criteria transportation problem, the solution with the highest level of satisfaction of all four fuzzy goals. Using the same numerical example as in Keshavarz and Khorram (2011), and solving it using the new algorithm, we obtained improved results, thus illustrating the effectiveness of our methodology.

The FBCTP may be solved using the new concepts of fuzzy solution to fuzzy optimization problems. In our future work we want to research the possibility to find the values of a membership function related to a certain fuzzy set solution to the FBCTP.

ACKNOWLEDGEMENTS

This research was partially supported by the Ministry of Education and Science, Republic of Serbia, Project numbers TR36006 and TR32013.

REFERENCES

Bellman, R., & Zadeh, L. (1970). Decision-making in a fuzzy environment, *Management Science, 17B,* 141-164.

Benson, H., (1978). Existence of efficient solutions for vector maximization problems, *Journal of Optimization Theory and Applications 26*(4), 569- 580.

Ebrahimnejad, A. (2014). A simplified new approach for solving fuzzy transportation problems with generalized trapezoidal fuzzy numbers, *Applied Soft Computing*, *19*, 171-176. doi:10.1016/j.asoc.2014.01.041.

Ehrgott, M., (2005). *Multicriteria Optimization*, Springer Verlag.

Kaur, A., & Kumar, A. (2012). A new approach for solving fuzzy transportation problems using generalized trapezoidal fuzzy numbers, *Applied Soft Computing 12*(3), 1201-1213. doi:10.1016/j.asoc.2011.10.014.

Keshavarz, E., & Khorram, E. (2011). A fuzzy bi-criteria transportation problem, *Computers & Industrial Engineering*, *61*(4), 947- 957. doi:10.1016/j.cie.2011.06.007.

Kocken, H.G., & Sivri, M. (2015). A simple parametric method to generate all optimal solutions of fuzzy solid transportation problem, *Applied Mathematical Modelling* (in press). doi:10.1016/j.apm.2015.10.053.

Kundu, P., Kar, S., & Maiti, M. (2015). Multi-item solid transportation problem with type-2 fuzzy parameters, Applied Soft Computing *31*, 61- 80. doi:10.1016/j.asoc.2015.02.007.

Li, F., Jin, C., & Wang, L. (2014). Quasi-linear stochastic programming model based on expectation and variance and its application in transportation problem, *Applied Mathematical Modelling, 38*(7-8), 1919- 1928. doi:10.1016/j.apm.2013.10.024.

Ojha, A., Das, B., Mondal, S. K., & Maiti, M. (2014). A transportation problem with fuzzy-stochastic cost, *Applied Mathematical Modelling, 38*(4), 1464- 1481. doi:10.1016/j.apm.2013.08.022.

Sabbagh, M. S., Ghafari, H., & Mousavi, S. R. (2015). A new hybrid algorithm for the balanced transportation problem, *Computers & Industrial Engineering 82,* 115- 126. doi:10.1016/j.cie.2015.01.018.

Sterzik, S., & Kopfer, H. (2013). A tabu search heuristic for the inland container transportation problem, *Computers & Operations Research, 40*(4), 953- 962. doi:10.1016/j.cor.2012.11.015.

Wang, G., Jia, N., Ma, S., & Qi, H. (2014). A rank-dependent bi-criterion equilibrium model for stochastic transportation environment, *European Journal of Operational Research, 235*(3), 511- 529. doi:10.1016/j.ejor.2014.01.023.

OPTIMAL ADJUSTMENTS OF ORDER QUANTITIES DUE TO PACKAGING AND TRUCK CONSTRAINTS

Aleksa Đolđević[1], Ana Belić[2], Dragana Makajić Nikolić*[3]
[1]Nelt Co. d.o.o. Dobanovci
[2]Alti d.o.o. Čačak
[3]University of Belgrade, Faculty of Organizational Sciences
*Corresponding author, e-mail:gis@fon.bg.ac.rs

Abstract *This paper present one problem that appear in supply chain from a perspective of a distributor in FMCG (fast–moving consumer goods), where goods are being ordered and sold every day in big quantities. Using predictive models for demand supply planning, planner calculate optimal quantities of products that should be delivered to retailers. However, these quantities rarely match with packaging units and truck weight limits and therefore must be adjusted. For solving the observed problem, mathematical model was formulated where we discuss two different ways of its application: obtaining of optimal weights and examination of the influence of packaging sizes on optimal vehicles loading. The optimization results show to decision maker how to avoid the decrease of DOC (days of coverage) and on the other hand to avoid increase of DOC for poorly performing products especially if they have high costs of stock-keeping. Second scenario shows that both proposed types of packaging are better in all performances than the results for pallet as packaging unit.*

Keywords*: supply chain, distributor, order quantities, mathematical model, optimization*

1. INTRODUCTION

A modern company must constantly respond to the huge challenges of the market and improve their business. To ensure optimal functioning, company has to react preventively and plan each of its activities. Distribution systems, which will be discussed in this paper as one of the most complex systems require constant analysis of supply chains. The challenge of coordinating operations across all facets of a business has become known as supply chain management (SCM) (Stank et al. 2001). Supply chain management can achieve significant savings by reducing the cost of inventory and planning, affect other business processes. SCM (Supply chain management) can be defined as integrated process wherein a number of various business entities (i.e., suppliers, manufacturers, distributors, and retailers) work together in an effort to: (1) acquire raw materials, (2) convert these raw materials into specified final products, and (3) deliver these final products to customers (Beamon, 1998). Another definition notes a supply chain is the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services delivered to the ultimate consumer (Christopher 1992). It involves two basic processes tightly integrated with each other: the production planning and inventory control process, which deals with manufacturing, storage, and their interfaces, and the distribution and logistics process, which determines how products are retrieved and transported from the warehouse to retailers (Tsiakis et al. 2001). Supply chain management is not just another name for logistics. It includes elements that are not typically included in a definition of logistics, such as information systems integration and coordination of planning and control activities (Cooper et al. 1997).

The term supply chain management has risen to prominence over the past ten years (Cooper et al. 1997) and has grown in importance, although the approach was introduced in early 1980 (Oliver and Webber 1982). This concept received considerable attention in the popular business press and in some academic literatures (Cooper et al. 1997).

Uncertainty plays an important role in the modern supply chain systems (Xu et al. 2003). Underestimating uncertainty and its impact can lead to planning decisions that might jeopardize a company. One of the key sources of uncertainty in any production-distribution system is the product demand. (Gupta et al. 2003). Having the competitive product and right supply chain is not enough thus supply chain has to be right for the individual customer as well (Hoover et al. 2001). Demand chain design is based on a thorough market understanding and has to be managed in such a way as to effectively meet differing customer needs (Treville

et al. 2004). Demand integration includes increased access to demand information throughout the supply chain to permit rapid and efficient delivery, coordinated planning, and improved logistics communication. (Treville et al. 2004). In a broader sense, DCM (Demand Chain Management) can be defined as "a set of practices aimed at managing and co-ordinating the whole demand chain, starting from the end customer and working backward to raw material supplier (Selen et al. 2002).

Demand Supply chain problem became attractive in recently years. Authors analyzed a one-supplier–one-retailer model (Weng, 1995), one-supplier–two-retailer case (Zheng et al. 2001), generalized the model to one-supplier–many retailer case. (Zheng et al. 2001) and studied the situation in which the price–demand relationship varied from period to period, but was known in each period. (Zhao et al. 2002).

This paper deals with one particular problem recognized at FMCG Company. The observed problem appears in operational planning at supply chains distributors. Based on demand data and information about retailer's inventory, planner should decide which quantities of products to deliver to retailer. The goal is to provide desired days of stock coverage. However, such quantities often do not correspond to the packaging units of products as well as the total products quantities often do not correspond to the desired capacities utilization of provided vehicles. In this paper, we formulate this operational decision as an optimization problem. This particular problem directly arise from real life and, according to our knowledge based on available literature, it is not previously formulated in that manner.

The paper consists of four sections. Section 2 is related to detailed description of the observed problem and its mathematical model formulations. Section 3 gives numerical results of a group of scenarios on real-life example of distributer of fast-moving consumer goods. Conclusions and directions of the further research are described in Section 4.

2. PROBLEM DESCRIPTION AND MATHEMATICAL MODEL FORMULATION

From the perspective of a distributor in FMCG (Fast-moving consumer goods), where goods are being ordered and sold every day in big quantities, demand and supply planner encounters many problems in day-to-day business. One of the issues which we are trying to improve using this model is the problem of fulfillment of a truck when ordering from the producer. As the biggest part of the transportation costs are fixed, therefore the distributor and the producer agreed on ordering at least 97% (q) of the full truck (Q).

However, using predictive models for demand supply planning, optimal ordering quantities rarely match with the truck weight limits (volume is not the issue in this problem as all the products are of a high density). Therefore, a planner has to modify optimal quantities he got using predictive models and adapt them to fill each truck with at least 97% of its maximum weight capacity.

Every product has defined its perfect inventory period (ip) which serves as a target when modeling ordering quantities, hence every change in suggested optimal ordering quantity will modify the actual days of coverage (DOC) which represents the number of days for which our goods on stock (iap) can fulfill the needs of forecasted sales (sf). The ideal quantity of each product which is used as a target during every order planning represents inventory theoretical (it) which is calculated as a sales forecast (sf) for the targeted inventory period (ip). Having in mind that between two orders (daily, weekly, monthly) some sales have happened which is commonly followed by uncertainty, a planner uses a formula where from inventory theoretical subtracting actual inventory at the moment of ordering and adding sales forecast for the period until the next moment of ordering to get the optimal ordering quantities (tr). Later in the model explanation, these optimal ordering quantities will be called the estimated weight of the product. Additionally, those optimal ordering quantities have to fulfill the packaging unit condition which means that the ordered quantity of every particular product has to be rounded to nearest integer of packaging units.

Following changes of optimal quantities to satisfy the packaging units and the truck fulfillment conditions can have two possible negative outcomes; if the quantity is decreased from optimal, there is a chance there will be not enough goods to satisfy the sales, hence being out of stock and miss the sales opportunity; if the quantity is increased, negative outcome is increasing costs of stock-keeping and having non-optimal cash flow.

First negative outcome is often considered more undesirable and that is why we are going to give a bigger penalty in our model if the order quantities are to be decreased from optimal (pd). Penalty for increasing the ordered quantity is defined as (pi).

The notation used in the mathematical model of the formulated problem is as follows.

N – set of products,

Parameters:

Q – capacity of the vehicle,

q - minimum required vehicles' charge status (%),

tr_j - the estimated weight of the j-th product to load into vehicles, $j \in N$,

p_j - packaging unit of the j-th product, $j \in N$,

iap_j - inventory actual

sf_j - sales forecast of the j-th product (weight), $j \in N$,

it_j - inventory theoretical of the j-th product (weight), $j \in N$,

ip_j - preferred DOC, inventory coverage of the j-th product (days), $j \in N$,

pi - penalty for increasing the preferred inventory coverage,

pd - penalty for decreasing the preferred inventory coverage.

Variables:

x_j - weight of the j-th product that should be to loaded into vehicles, $j \in N$,

y_j - number of packages of the j-th product that should be to loaded into vehicles, $j \in N$,

z - number of vehicles needed for transportation,

di_j - increasing the preferred inventory coverage for the j-th product (days), $j \in N$,

di_j - negative deviation variables for the tr_j, increasing of the estimated weight of the j-th product to load into vehicles, $j \in N$,

dd_j - positive deviation variables for the tr_j, decreasing of the estimated weight of the j-th product to load into vehicles, $j \in N$,

$doci_j$ - negative deviation variables for the ip_j, increasing of the preferred DOC for the j-th product (days), $j \in N$,

$docd_j$ - positive deviation variables for the ip_j, decreasing of the preferred DOC for the j-th product (days), $j \in N$,

Using the introduced notation, the following mathematical model was formulated:

$$(\min)\ \ pi \cdot \sum_{j \in N}` doci_j + pd \cdot \sum_{j \in N}` docd_j \tag{1}$$

s.t.

$$x_j - di_j + dd_j = tr_j,\ j \in N \tag{2}$$

$$\sum_{j \in N}` x_j \geq Q \cdot q \cdot z \tag{3}$$

$$\sum_{j \in N}` x_j \leq Q \cdot z \tag{4}$$

$$\frac{ip_j \cdot (iap_j - sf_j + x_j)}{it_j} - doci_j + docd_j = ip_j,\ j \in N \tag{5}$$

$$x_j - p_j \cdot y_j = 0,\ j \in N \tag{6}$$

$$x_j \geq 0, di_j \geq 0, dd_j \geq 0, doci_j \geq 0, docd_j \geq 0, y_j \in \square^+, j \in N$$

Objective function (1) minimize total penalized increasing and decreasing the prefered DOC. The constraint (2) is related to the estimated weights of the products. These weights can not always be satisfied because of the products packaging units and vehicles capacities. Therefore, deviations are allowed but not penalized. The constraints (3) and (4) refer to the minimum and maximum vehicle capacity that must be reached and must not be exceeded. The constraint (5) is related to the preferred DOC which cannot always be reached for the same reasons stated in the constraint (2). Since the main goal of the transport planning is to achieve preferred DOCs, negative and positive deviations are penalized in the objective function. The constraint (6) conects two types of variables (weight and the number of packages of the j-th product) and ensure that the optimal weight of the product corresponds to the integer number of packages.

Note: Variable z that appears in constraints (3) and (4) can be defined as parameter if desired number of vehicle is known in advance.

3. NUMERICAL RESULTS

In order to evaluate the proposed mathematical model (1-6) we discuss two different ways of its application. First one refers to obtaining of optimal weights i.e. number of packages of products that should be loaded into vehicles in order to fulfill requested vehicle capacity with minimal disturbance of required days of coverare. The second application is related to the examination of the influence of packaging sizes on optimal vehicles loading.

Both applications will be ilustrated on a range of 234 products in the field of cosmetics and household chemicals. Total estimated weight of the products is 123947.621kg. Since the capacity of one vehicle is 23500kg this weight requires 5.2744 vehicles. It is obvious that the estimated weights of the products should be adjusted to fulfill whole number of vehicles. In addition, estimated weights of the products in most cases do not correspond whole numbers of packages. Therefore, this type of adjustment is also needed.

In determining the optimal weights of products that should be loaded into vehicles, the following four scenarios was tested:

1. Decreasing the preferred DOC is penalized five times more than its increasing; z is a variable.
2. Penalties for decreasing and increasing are the same; z is a variable.
3. Decreasing the preferred DOC is penalized five times more than it's increasing; z is a parameter equal to 5.
4. Penalties for decreasing and increasing are the same; z is a parameter equal to 5.

The model (1-6) has been implemented and solved using GNU Linear Programming Kit (GLPK, 2016). The optimal solutions for all four scenarios are shown in Table 1. In addition to total penalized increasing and decreasing (Objective), number of vehicles and total weight of optimal products quantities, Table 1 gives maximal inreasing and decreasing of DOC for each solution. The right part of the table shows the number of products for which increasing of DOC is between 2 and 5 days i.e. up to one week (column 1w), between 5 and 10 days i.e. 1 to 2 weeks (column 2w) and more than 10 days i.e. 2 weeks (column >2w). Analogue values are given in columns named DOC decreasing.

Table 1. Optimal solutions

				max DOC		DOC increasing			DOC decreasing		
Scenario	Objective	Number of vehicles	Total weight	inc	dec	1 w	2 w	> 2 w	1 w	2 w	> 2 w
1	188.581	6	136779	11.069	-1.048	37	5	1	1	0	0
2	130.537	6	136771	9.091	-8.660	19	3	0	10	1	0
3	222.168	5	117496	11.069	-5.372	34	5	1	0	1	0
4	138.381	5	117491	9.091	-8.660	17	3	0	12	1	0

Although the lower value of the objective function is achieved in the scenario 2, it requires one vehicle more than scenarios 3 and 4. In practice, the decision-maker would decide to fill 5 rather than 6 vehicles considering that the total estimated weight of products required 5.27 vehicles. Therefore, only scenarios 3 and 4 should be considered. Values of objective functions in these two scenarios are incomparable due to

the different penalties for DOC decreasing. In addition, none of these two scenarios dominating in all deviations of DOCs. Scenario 3 gives lower maximal DOC decreasing but higher maximal DOC increasing and more products with DOC deviation than scenario 4. On the other hand, scenario 4 gives 12 products with DOC decreasing more than scenario 3. Therefore, the final decision is on the decision maker. However, the decision maker should always have in mind prioritized products with high importance to avoid the decrease of DOC and on the other hand to avoid increase of DOC for poorly performing products especially if they have high costs of stock-keeping.

The packaging unit for about the half of the product portfolio in the previous example is the pallet. This is the main reason for the inability to obtain solutions with 5 vehicles in the scenarios 1 and 2, although the required number of vehicles based on estimated weight of the products is closer to 5 than 6. Hence, we have investigated how smaller packaging units influence on optimal weights of products and consequently optimal number of vehicles. Table 2 gives optimal solution for four previously defined scenarios when packaging units are layers (P1) and cases (P2) instead of pallets.

Table 2. Optimal solutions with smaller packaging units

Packaging unit	Scenario	Objective	Number of vehicles	Total weight	max DOC		DOC increasing			DOC decreasing		
					inc	dec	1 w	2 w	> 2 w	1 w	2 w	> 2 w
P1	1	106.541	6	136773	6.258	-0.409	19	2	0	0	0	0
	2	69.867	5	117494	4.080	-3.148	8	0	0	7	0	0
	3	126.648	5	117500	6.258	-3.787	18	2	0	1	0	0
	4	69.867	5	117494	4.080	-3.148	8	0	0	7	0	0
P2	1	92.8418	6	136772	6.258	-0.409	16	3	0	0	0	0
	2	60.1435	5	117500	4.080	-3.361	8	0	0	5	0	0
	3	107.128	5	117499	6.258	-3.558	16	2	0	1	0	0
	4	60.1435	5	117500	4.080	-3.361	8	0	0	5	0	0

The results obtained for both types of packaging are better in all performances than the results for pallet as packaging unit. However, if high penalty is given to the DOC decreasing (scenario 1), optimal solution with 5 vehicles cannot be obtained, regardless packaging unit. Finally, using layers as packaging units is more appropriate than cases due to reception issues in a warehouse where cases of the same product could be dispersed among different pallets and with layers that's not of concern.

4. CONCLUSION

The subject of this paper is one optimization problem that is recognized in real life FMCG distribution company. Planners are faced ones a week with the problem of determining the quantities of products that should be delivered to retailers. Based on demand and retailer's inventory data, planners calculate the quantities of products that provide the desired days of stock coverage. Since these quantities usualy do not correspond to packaging units and vehicle capacities, they should be adjusted. In this paper, we have observed that problem as an optimization problem and formulated corresponding mixed integer mathematical model. The proposed models can be used at two level. The first use is for obtaining the optimal weights of products that should be loaded into vehicles. The second use is related to the examination how packaging sizes influence on optimal vehicles loading. Both application were illustrated on FMCG company. Obtained results show that, as expected, package units smaller than pallets provide better adjustment. However, the final decision about packaging units should be made by responsible decision maker, which is enabled by the proposed approach.

The proposed mathematical model includes determination of the number of vehicles assuming they are of the same capacity. Since, the capacities of vehiclel can differ, observed problem could be modified by introducing the assignment of products to individual vehicles. The inclusion of this feature into the problem would require the modification of the mathematical model and, probably, development of appropriate heuristic.

REFERENCES

Beamon, B. M. (1998). Supply chain design and analysis:: Models and methods. *International journal of production economics*, *55*(3), 281-294.

Chen, F., Federgruen, A., & Zheng, Y. S. (2001). Coordination mechanisms for a distribution system with one supplier and multiple retailers. *Management Science*, *47*(5), 693-708.

Christopher, Martin L. (1992), Logistics and Supply Chain Management, London: Pitman Publishing.

Cooper, M. C., Ellram, L. M., Gardner, J. T., & Hanks, A. M. (1997). Meshing multiple alliances. *journal of Business Logistics*, *18*(1), 67.

Cooper, M. C., Lambert, D. M., & Pagh, J. D. (1997). Supply chain management: more than a new name for logistics. *The international journal of logistics management*, *8*(1), 1-14.

De Treville, S., Shapiro, R. D., & Hameri, A. P. (2004). From supply chain to demand chain: the role of lead time reduction in improving demand chain performance. *Journal of Operations Management*, *21*(6), 613-627.

GLPK (2016), available at: http://www.gnu.org/software/glpk/ (accessed 15 March 2016).

Gupta, A., & Maranas, C. D. (2003). Managing demand uncertainty in supply chain planning. *Computers & Chemical Engineering*, *27*(8), 1219-1227.

Hoover, W. E., Eloranta, E., Holmstöm, J., & Huttunen, K. (2001). Managing the Demand Chain.

Jüttner, U., Christopher, M., & Baker, S. (2007). Demand chain management-integrating marketing and supply chain management. *Industrial marketing management*, *36*(3), 377-392.

Lambert, D. M., & Cooper, M. C. (2000). Issues in supply chain management. *Industrial marketing management*, *29*(1), 65-83.

Oliver, R. K., & Webber, M. D. (1982). Supply-chain management: logistics catches up with strategy. *Outlook*, *5*(1), 42-47.

Selen, W., & Soliman, F. (2002). Operations in today's demand chain management framework. *Journal of Operations Management*, *20*(6), 667-673.

Stank, T. P., Keller, S. B., & Daugherty, P. J. (2001). Supply chain collaboration and logistical service performance. *Journal of Business logistics*, *22*(1), 29-48.

Tsiakis, P., Shah, N., & Pantelides, C. C. (2001). Design of multi-echelon supply chain networks under demand uncertainty. *Industrial & Engineering Chemistry Research*, *40*(16), 3585-3604.

Weng, Z. K. (1995). Channel coordination and quantity discounts. *Management science*, *41*(9), 1509-1522.

Weng, Z. K., & Zeng, A. Z. (2001). The role of quantity discounts in the presence of heterogeneous buyers. *Annals of Operations Research*, *107*(1-4), 369-383.

Xu, M., Qi, X., Yu, G., Zhang, H., & Gao, C. (2003). The demand disruption management problem for a supply chain system with nonlinear demand functions. *Journal of Systems Science and Systems Engineering*, *12*(1), 82-97.

Zhao, W., & Wang, Y. (2002). Coordination of joint pricing-production decisions in a supply chain. *IIE transactions*, *34*(8), 701-715.

OPTIMAL HETEROGENEOUS STAFF SCHEDULING IN CASE OF PLANNING A SPECIAL EVENT

Maja Hadžiahmetović*, Minja Marinović,
Universtiy of Belgrade, Faculty of Organizational Sciences
*Corresponding author, e-mail: hadziahmetovic.maja@fon.bg.ac.rs

Abstract: *In this paper a scheduling staff problem with multiple work skills in case of planning a special event is presented. This problem can be quite challenging because each special event has different conditions regarding days of preparation, activities which need to be done, the number of staff required and their qualification. However, not all staff members, whether they are a part of organizational management, interns or volunteers possess all of the required skills, and they cannot be available at all times which can bring to the scheduling problem. This paper deals with such problem, introducing an original mathematical model used on a real-life example of scheduling staff for the Knight Fest held each year in Belgrade, Serbia. The problem is formulated and solved using goal programming model.*

Keywords: *staff scheduling, goal programming, optimization, heterogeneous staff, multi-skill workforce*

1. INTRODUCTION

Scheduling staff represents a problem where organization assigns working schedules to its employees in order to meet the demand for the goods or services they provide. (Ernst et al. 2004) These schedules have a purpose of maximizing the employees' productivity or their preferences towards shifts, days off or holidays or minimize the costs of their assignment or even both. However, it is rather complicated to find the optimal solution to this problem since there are many conditions to meet in the organization itself as well outside of it. The cause of this complexity is that there are many government rules regarding staff deployment which vary from one country to another.

Staff scheduling as an optimization problem has become an extremely important and popular area in the field of operations research. The reason for that is that there are always new problems which occur in different branches of business where each requires special approaches, methods and applications. This is why there are many ways of solving scheduling problems, especially because there is no universal solution because each organization no matter what its' core businesses, has unique ways of functioning, deployment politics, or government regulations which need to be taken into account. However, what all of these organizations have in common is to use their staff in the most efficient way. Personnel scheduling is applicable at most for scheduling medical staff, see (Hall, 2012), (Cheang et al. 2003), (Azaiez and Al Sharif 2005), call center operators, see Avramidis et al. (2010), Stefanov et al. (2014) and airline companies (Brusco et al. 1995), (Barnhart et al. 2003) .

Assignment staff problem started to occur in the fifties of the XX century. The interest of science for this area and the subject continues to this day, even though the problem had some significant changes from the Dantzig (1954) and Edie`s (1954) problem that has been related to traffic delays at toll booths. One of the first classification methods for assigning staff was presented by Baker (1976), in which he presented three types of problems of scheduling staff. The first type covers scheduling shifts “shift scheduling”, the second type is related to “days-off scheduling” while the third type presents the combination of first two types (tour scheduling). Alfares (2004) proposes ten categories for staff allocation: (1) manual solution, (2) integer programming, (3) implicit modeling, (4) decomposition, (5) goal programming, (6) working set generation, (7) LP-based solution, (8) construction and improvement, (9) metaheuristics, (10) other methods. When it comes to literature review on this subject, comprehensive literature review of classical studies on this problem is given in Ernst et al. (2004) while the extensive amount of covered papers on this subject is presented by Van Den Bergh et al. (2012) Present scheduling staff problem can be divided according to belonging areas, with the largest number of published papers focused on allocating staff employed in airlines, medical personnel and call center’s operators as a new form of staff allocation. A similar problem of scheduling heterogeneous staff with part-time employees with limited availability is presented by Hojati and Patil (2010). Scheduling employees method that combines two-step procedure in one which iterates between

a schedule evaluator and a schedule generator is presented by Ingolfsson et al. (2011). Mohan (2008) suggests another approach for maximizing employees` satisfaction with certain restrictions considering their availability, preferences for the shifts and seniority level.

This paper presents a heterogeneous staff scheduling problem in case of planning a special event. This is a special form of staff deployment, since it is limited in time, requires a great number of staff with different skills, the tasks which need to performed have multiple level of difficulty. Consequently, it is possible to employ volunteers or interns since the days of preparation usually last much more than the event itself and they are carried out on various locations. The suggested solution would provide an optimal schedule of all staff depending on their skills and availability, respecting conditions concerning a minimal and a maximum number of staff allowed in order to minimize the costs of their assignment for each day required for the organization and preparation of the event itself. The problem was formulated using 0-1 goal programming model and solved exactly. Therefore, it would be needed to change only the input data about staff availability and to get a new optimal solution for each day necessary until the event is over.

The paper is organized as follows. After the introductory part, Section 2 describes a problem of scheduling employees in case of special events. Section 3 describes model formulation and presents an original mathematical model for the solving problem described in Section 2. Numerical results are presented in Section 4 and discussed in the real-life example of staff scheduling for the manifestation named Knight Fest. Conclusions and suggestions regarding future work are given in Section 5.

2. PROBLEM DESCRIPTION

The paper discusses a problem of determining the optimal schedule of staff members with different hierarchy levels when planning a special event. Each special event has different organizational goals and a specific way of deployment of its employees. This means that there is no common solution when planning events such as these since each event differs from other significantly. For that reason, it can be rather challenging to schedule employees where there is not a common pattern of work to follow or shifts to change on a daily or weekly level. These types of scheduling often require a large number of staff and recourses for the sake of everything to look the most authentic and go as planned. That is why the organization has to be done days, usually months in advance which leads to the fact that plenty of staff needs to be hired in order to everything go well. The staff is usually divided into groups, depending on their wages, position, availability and the scope of work they do. Since there is a vast number of activities which have to be done, it is expected that not all staff member are qualified to do them all. Especially because most special events demand to hire a large number of volunteers and interns to do less complex jobs, which do not require special skills, for a small or no fee included. This is why staff member with experience are eligible to work on all activities, where interns and volunteers do not have to be familiar with all of the activities which need to be done.

Besides the diversity in staff members, there are many activities which contribute to the organization itself, before the main event occurs. These activities, among many, may include marketing, promotion, organizational and IT skills and they have to be held in various locations depending on the prepared timeline. At each location, the activities are carried out in several terms during the day.

For each of these terms, there is a minimal number of available staff required, where it is necessary that, at least, one of the staff with experience (neither a volunteer nor an intern) is present during each term and location. Even though the volunteers do not receive a salary, a certain amount of money has to be set aside for their meals, transportation etc. Interns, however, do receive a salary, but it is significantly lower than managers' due to the fact they do not have as much experience. Since there is a difference in working hours for each of the group of staff, their availability during the day may vary. Depending on their function for each group the assigned number of given terms is different, including the fact that not all of them are available every day and every term. For example, the volunteers may be assigned to not more than two terms and locations during one day, interns have a maximum number of three terms and locations, where experienced staff should work four terms during one day (and four locations). The break period usually lasts one hour between terms and it could be used for rest, meals and switching locations if they were assigned so.

Taking everything into account, it is necessary to create an optimal schedule and assign all activities to staff members for each day, respecting the given constraints in order to minimize costs needed to pay staff members.

3. MODEL FORMULATION

In the formulation of a mathematical model for optimal staff scheduling using goal programming, the following notation has been used:

Sets:

I – set of all staff that need to be scheduled, $i \in I$,
I_v – set of volunteers, $I_v \subset I$
I_o – set of organizational managers, $I_o \subset I$,
I_p – set of interns, $I_p \subset I$, $I_v \cup I_o \cup I_p = I$,
J – set of activities, $j \in J$,
K – set of locations, $k \in K$
T – set of terms during the day, $t \in T$

The variable X can be described as follows:

$$x_{ijkt} = \begin{cases} 1 & \text{if staff member } i \text{ is assigned to the activity } j \text{ on the location } k \text{ in the term } t \\ 0 & \text{otherwise} \end{cases}$$

The matrix A describes whether the certain staff member is qualified to do the given activity. The elements of the matrix A are:

$$a_{ij} = \begin{cases} 1 & \text{if staff member } i \text{ is qualified to do the activity } j \\ 0 & \text{otherwise} \end{cases}$$

The elements of the matrix A could also be real numbers from 0 to 1, giving the fact that perhaps, some staff members are more or less familiar with a certain activity. In this case, number one would mean that the staff member *i* is fully familiar with the activity *j,* and zero would mean that he is not familiar at all.

As mentioned above, not all members are available to work every term of the day on each location. The matrix B shows if a staff member *i* is available to work on the given term and location. The elements of matrix B are:

$$b_{ikt} = \begin{cases} 1 & \text{if staff member } i \text{ is available on the location } k \text{ in the term } t \\ 0 & \text{otherwise} \end{cases}$$

Mathematical model of staff scheduling is described as follows:

$$\min \sum_{i \in I} \sum_{j \in J} \sum_{k \in K} \sum_{t \in T} c_i \cdot x_{ijkt} \tag{1}$$

s.t.

$$\sum_{i \in I} \sum_{j \in J} x_{ijkt} \le p_{kt}, \; k \in K, \; t \in T \tag{2}$$

$$\sum_{i \in I} \sum_{j \in J} x_{ijkt} \ge d_{kt}, \; k \in K, \; t \in T \tag{3}$$

$$\sum_{i \in I_o} x_{ijkt} \ge 1, \; j \in J, \; k \in K, \; t \in T \tag{4}$$

$$\sum_{i \in I_p} x_{ijkt} \ge mip_{jkt}, \; j \in J, \; k \in K, \; t \in T \tag{5}$$

$$\sum_{i \in I_v} x_{ijkt} \ge miv_{jkt}, \; j \in J, \; k \in K, \; t \in T \tag{6}$$

$$\sum_{j \in J} x_{ijkt} \leq b_{ikt}, \; i \in I, k \in K, t \in T \tag{7}$$

$$x_{ijkt} \leq a_{ij}, \; i \in I, j \in J, k \in K, t \in T \tag{8}$$

$$\sum_{j \in J} \sum_{k \in K} \sum_{t \in T} x_{ijkt} \leq mv, \; i \in I_v \tag{9}$$

$$\sum_{j \in J} \sum_{k \in K} \sum_{t \in T} x_{ijkt} \leq mp, \; i \in I_p \tag{10}$$

$$\sum_{j \in J} \sum_{k \in K} \sum_{t \in T} x_{ijkt} \leq mo, \; i \in I_o \tag{11}$$

$$\sum_{j \in J} \sum_{k \in K} x_{ijkt} \leq 1, \; i \in I, \; t \in T \tag{12}$$

The goal function (1) minimizes the costs which need to be paid for each worker. The parameter c_i represents the cost for the staff member *i*, regardless of the skill level they possess. The majority of these costs include wages, but these costs include expenses such as food or transportation since volunteers do not receive wages for the activities they do. Constraints (2) and (3) refer to the maximum and minimal number of staff on each location and term of the day, where parameters p_{kt} and d_{kt} represent these numbers respectively. Constraints (4)-(6) represent a minimal number for each staff group for every activity, term and on each location. Parameters miv_{jkt}, mip_{jkt}, mio_{jkt} are integer numbers for each group. The seventh constraint assigns location and term for each available staff member defined by matrix B. Constraint (8) provides that only qualified members for certain activities are assigned to those activities. Constraints (9)-(11) describe a maximum number of locations which need to be assigned. For volunteers that number is two, for interns three, and for organizational managers, the maximum number of locations is four. Finally, constraint (12) provides that it is impossible to assign the same term for different location when it comes to the staff member *i*.

4. NUMERICAL RESULTS

Each year a traditional manifestation, the Knight Fest, is held in Belgrade, Serbia. The Knight Fest is a multimedia knight spectacle which is held on a great children holiday – Lazarus' Saturday/Palm Sunday on Belgrade fortress ("Knight Fest", 2016). The event falls into one of the most interesting events of this type, and it is a major tourist attraction.

The main event, the festival itself, is held on Belgrade fortress while the activities concerning preparation and promotion of the festival are held in various locations in Belgrade such as city center, shopping malls and other manifestations and events. Activities consist of festival organization, marketing activities, human resources activities (HR), knowing knight skills (such as fencing, horsemanship, and medieval warfare), logistics and IT skills, and all of these activities are held in locations mentioned above. The staff is divided into three groups, in total of 98 persons, and they all consist of eight organizational managers, 20 interns and 70 volunteers, where interns and volunteers do not have the full-time commitment; however, there is a difference in working hours for both of these groups. The whole preparation lasts for 15 days (including the two days of the festival), and each day consists of five terms which last two hours and between the terms there is a break included. The first term starts at 8:00 AM, and the last finishes at 10:00 PM. The maximum number of terms for each of these groups varies. The volunteers should not work more than two terms per day, the interns three, while the organizational managers not more than four terms a day. However, there should always be present at least one member of the organizational management to supervise and give additional help to interns and volunteers. There is as well a maximum and a minimal number of all staff members for each location and each term, and a minimal number of interns and volunteers for each activity, location and term. For example, if a minimal number for each term in on the certain location for interns and volunteers is 10 for all activities given above, and there is at least one member of organizational managers included that would be a total of at least 11 staff members. In spite of this, the minimal number for that location and term is 15. Therefore, four additional members must be assigned depending only on their availability and costs.

These minimal numbers for terms and locations excluding the qualifications are eight for all shopping malls, 15 for the city center and 20 for each place on the Belgrade fortress, while the minimal number for each activity, location and term varied from two to five depending on the term itself, size and attractiveness of the locations and number of activities which could be performed there.

The problem was observed on one day, and it could be applicable to all days of the festival, including the preparation and the manifestation itself, changing only the input data about availability of the staff and the quotes for the maximum and minimum number regarding the terms, activities and locations.

The problem was successfully solved using the GNU *Linear Programming Kit* (GLPK) (GLPK, 2016), open source software for solving problems of linear and mixed integer programming, on the computer with the following specifications: *Intel(R) Core (TM) i7-2600 CPU* (3.40 GHz), *RAM* 12 GB. The process of finding the optimal integer solution took 0.3 seconds. This problem contains 123480 variables. The goal function value is 13650 monetary units. The optimal solution for the each term is shown in Tables 1-5.

Table 1: Optimal solution for staff scheduling problem shown for the first term

	Location1	**Location2**	**Location3**	**Location4**	**Location5**	**Location6**
Organization	1o,3v	1v	1p	1v	2p,2v	3v
Logistics	2p,1v	1o,1v	2v	1p	3v	1o,1p,2v
Marketing	1v	1p	1o	1v	3v	2p,2v
Knight skills	2v	2v	2v	3v	1o,5v	3v
HR	1p,3v	1v	1p	1o	2v	2v
IT	2v	1v	1p	1v	2p	2p,2v

Table 2: Optimal solution for staff scheduling problem shown for the second term

	Location1	**Location2**	**Location3**	**Location4**	**Location5**	**Location6**
Organization	2v	1v	1p	1v	3v	2p,1v
Logistics	3p,1v	1p,	2v	1o,	3v	1p,2v
Marketing	2v	1o,1v	1o,	1v	3v	3v
Knight skills	2v	2v	2v	1v	1o,1p,2v	5v
HR	1o,1v	1p	1v	1p	4p	1o,1p
IT	1p,2v	1v	1p	3v	3v	4v

Table 3: Optimal solution for staff scheduling problem shown for the third term

	Location1	**Location2**	**Location3**	**Location4**	**Location5**	**Location6**
Organization	4v	1v	1v	1v	1o,3v	1o,1p
Logistics	1o,1v	1p	1o,1v	1p,1v	4v	3v
Marketing	4v	1v	1p	1o,	1p,2v	1p,3v
Knight skills	1p,2v	2v	2v	1p	1p,3v	5v
HR	1v	1o,1v	1v	1v	3v	1p,2v
IT	1v	1p	1v	2v	1p,1v	3v

Table 4: Optimal solution for staff scheduling problem shown for the fourth term

	Location1	**Location2**	**Location3**	**Location4**	**Location5**	**Location6**
Organization	6v	2p	1o,	1o	4v	3v
Logistics	1o,1v	1o	2p	1p	1o,4v	1p,3v
Marketing	2v	1v	1v	1v	3v	4v
Knight skills	1p,2v	1p	2v	1p	1v	2p
HR	1v	1v	1v	3v	1o	1o,1p,2v
IT	1v	2v	1p	1v	2p,2v	3v

Table 5: Optimal solution for staff scheduling problem shown for the fifth term

	Location1	**Location2**	**Location3**	**Location4**	**Location5**	**Location6**
Organization	2p,1v	1p	1o,	1p	1o,3v	2p,1v
Logistics	1o,1v	1v	2v	1o,	2v	1o,3v
Marketing	2v	1v	1p	1v	1v	3v
Knight skills	2v	2v	2v	1v	2p,3v	1p,2v
HR	1o,2v	1o,	1v	3v	4v	5v
IT	2p,1v	1p,1v	1p	1p	1p,3v	1p,1v

Tables 1-5 present the optimal schedule for the each term of one day in the organization the Knight Fest. The integer number before the letter shows how many of certain type of staff is assigned to given activities and locations, where the letter *o* stands for the organizational manager, letter *v* for volunteers and the letter *p* stands for interns. From the Table 1, it is possible to conclude that there is a total of 6 organizational managers, 56 volunteers and 17 interns assigned in total for the mentioned activities and locations. The minimal number of all staff members in the first term and location1 was 15 and the minimal number for each activity was 4, 2, 1, 1, 2, 1 respectfully as given in the table. This means that there were four staff members

to assign additionally in order to fulfill the constraint regarding the minimal number. This was achieved by assigning four extra volunteers who were available regardless of their qualification. The same observation can be applied to other four tables. One interesting example can be found in term 5 on location1 where there was a need for a minimum of one organizational manager, three interns, and seven volunteers, but because of unavailability of volunteers software found a solution with only two additional volunteers, one additional organizational manager and one additional intern.

5. CONCLUSION AND FURTHER RESEARCH

The subject of this paper is the problem of scheduling heterogeneous multi-skill staff in case of organizing a special event. Although the staff scheduling problem, in general, was recognized more than sixty years ago, most organizations still perform this type of work manually, without the help of software which causes more time, energy and there is no warranty that the solution found this way would be even acceptable, nevertheless optimal. The paper proposed an optimal solution to a certain problem of this type – staff scheduling in case of planning and organizing a special event, as a specific type of staff scheduling. Since the schedule is applicable only for the time of the event whereas its preparation is limited in time, its organization requires multiple locations where different activities are carried out. Therefore, additional staff can be deployed and for less complex activities it is possible to hire volunteers or students as a part of their internship program. This is why it can be quite complex to create an optimal schedule which would provide minimal costs of deployment and respect all the conditions which were given. The problem was observed on the real-life example and translated into a mathematical model using 0-1 goal programming model and successfully solved using GLPK software.

The problem was scheduling multi-skill heterogeneous staff in order to plan a manifestation named The Knight Fest held each year in Belgrade, Serbia. The festival required around two weeks in total for preparation and the manifestation itself. For each day there were several locations to work on, and various activities had to be carried out. A single day was observed for this problem, where each day had five terms where actual work had to be done, and four breaks between. The staff assigned to this event consisted of organizational managers, interns and volunteers, unevenly distributed. Each of these groups had different wages and limitations concerning the minimal number of each group, the maximum number of the locations and terms which needed to be assigned to them and their availability and qualifications were taken into account.

Since the problem was observed on a single day of the festival organization, the future research could include planning for every day of the organization. This would probably lead to the fact that staff could have certain shifts and maybe a fixed working schedule. Also, it could lead to assigning the same activities to the same people during whole 15 days. As said before, their qualifications could be real numbers from 0 to 1 so it should be aimed to maximize their qualifications as well as minimizing costs which would lead to multi-criteria optimization. One of the ideas could be to decide whether is it better to deploy one organizational manager or two volunteers since in this proportion their wages would be very similar but the amount of work, knowledge and decision-making process would be different when it could be possible to choose between these two options.

6. REFERENCES

Alfares, H. K., (2004). Survey, categorization, and comparison of recent tour scheduling literature. *Annals of Operations Research*, 127(1-4), 145-175.

Avramidis, A. N., Chan, W., Gendreau, M., L'ecuyer, P., &Pisacane, O. (2010).Optimizing daily agent scheduling in a multiskill call center. *European Journal of Operational Research*, *200*(3), 822-832.

Azaiez, M., & Al Sharif, S. (2005). A 0-1 goal programming model for nurse scheduling. *Computers & Operations Research, 32*, 491-507.

Baker, K. R., (1976). Workforce allocation in cyclical scheduling problems: A survey. *Operational Research Quarterly*, 27(1), 155-167.

Barnhart, C., Cohn, A. M., Johnson, E. L., Klabjan, D., Nemhauser, G. L., & Vance, P. H. (2003).Airline crew scheduling.In *Handbook of transportation science* (pp. 517-560).Springer US.

Brusco, M. J., Jacobs, L. W., Bongiorno, R. J., Lyons, D. V., & Tang, B. (1995). Improving personnel scheduling at airline stations. *Operations Research*, *43*(5), 741-751.

Cheang, B., Li, H., Lim, A., Rodrigues, B. (2003). Nurse rostering problems—a bibliographic survey, European Journal of Operational Research, 151, 447–460.

Dantzig, G. B., (1954). Letter to the Editor-A Comment on Edie's "Traffic Delays at Toll Booths". *Journal of the Operations Research Society of America*, 2(3), 339-341.

Edie, L. C., (1954). Traffic delays at toll booths. *Journal of the operations research society of America*, 2(2), 107-138.

Ernst, A., Jiang, H., Krishnamoorthy, M., &Sier, D., (2004). Staff scheduling and rostering: A review of applications, methods and models. European Journal of Operational Research, 153 (1), 3–27 .

GNU *Linear Programming Kit* GLPK (2016). Retrieved from http://www.gnu.org/s/glpk/

Hall, R. (2012). *Handbook of healthcare system scheduling*.Springer Science+ Business Media, LLC.

Hojati,M.,&Patil, S. A., (2011). An integer linear programming based heuristic for scheduling heterogeneous, part-time service employees, *European Journal of Operational Research*, 209(1), 37-50.

Ingolfsson, A.,Campello, F., Wu, X., & Cabral, E., (2010).Combining integer programming and the randomization method to schedule employees, *European Journal of Operational Research*, 202(1), 153-163.

Knight fest organization (2016).Retrieved from http://www.vitezfest.org

Mohan.S.,(2008).Scheduling part-time personnel with availability restrictions and preferences to maximize employee satisfaction,*Mathematical and Computer Modeling,* 48(1),1806–1813.

Stefanov, D, Kostić-Stanković, M, Makajić Nikolić D, (2014) Raspoređivanje operatera u službi podrške kontakt centra komercijalne banke AD Beograd. Zbornik radova XLI SYMOPIS, Divčibare, 355-360

Van Den Bergh, J., Beliën, J., De Bruecker, P., Demeulemeester, E., & De Boeck, L., (2012). Personnel scheduling: A literature review. European Journal of Operational Research, 26 (3), 367–385 .

AGENT-BASED MODELS: A REVIEW OF APPLICATIONS

Nikola Zornic*[1], Aleksandar Markovic[1]
[1]University of Belgrade, Faculty of Organizational Sciences
*Corresponding author, e-mail: nikola.zornic@fon.bg.ac.rs

Abstract: *Agent-based models (ABMs) have been used in various fields of science with growing interest. After a description of the approach, some interesting bibliometric data on ABM usage in numerous fields is presented, including a citation network analysis. Almost 3000 papers from Thomson Reuters Web of Science (Science Citation Index Expanded and Social Sciences Citation Index) databases have been scrutinized in terms of keywords and field of application, as well as publishing frequency in the observed journals for the period 2000-2015. Examples of thought-provoking usage in solving optimization problems and analysis of customer behaviour are also presented to depict the vast applicability.*

Keywords*: agent-based model, agent-based simulation, application review, bibliometrics, literature review*

1. INTRODUCTION

Agent-based models (ABMs) consist of a set of elements (agents) characterized by specific attributes, which interact with each other through the definition of appropriate rules in a given environment. ABMs can be used to reproduce systems related to ecology (Gerst et al., 2013), economy (Shafiei et al., 2012), agriculture (Rebaudo & Dangles, 2013), medicine (Kasaie, Andrews, Kelton, & Dowdy, 2014), to solve optimization problems (Nikolopoulou & Ierapetritou, 2012), and many others. The use of ABMs can help in understanding properties and patterns concerning the whole scenario (Billari, Fent, Prskawetz, & Scheffran, 2006) that could not be anticipated nor predicted by the observation of agents individually due to the complexity of the interactions among the elements of the system (Barbati, Bruno, & Genovese, 2012). Wooldridge and Jennings (1995) defined agent as computational system interacting with an environment, that can be described with the following features:

- *Independence* - Each agent acts without the direct control of human beings or other devices.
- *Social ability* - Interactions occur among agents through a communication language with the aim to satisfy the objectives.
- *Re-activeness* - Agents answer in a precise way to signals coming from the environment.
- *Pro-activeness* - Agents are capable of acting goal-directed. They take the initiative in order to satisfy their objectives.

Furthermore, it can be concluded from Billari et al. (2006) and Weiss (1999), that the development of an ABM needs a set of basic building blocks to be defined:

- *The object of the simulation* - It has to be specified what is the phenomenon/problem to be reproduced. Also, space, where the simulation takes place, has to be defined.
- *The agents' population* - Agents can be grouped into different categories with common characteristics, reproducing the various components of the reproduced system.
- *The adaptive capability of each agent category* - Agents of each category present a specific adaptive capability, i.e. the degree of reactiveness and pro-activeness.
- *The interaction paradigm among agents* - Each agent can interact with agents of the same or another category. In this context, agents can be competitive if they have conflicting objectives and non-competitive otherwise. In the literature, various interaction paradigms have been defined, which can be mainly classified as *Cooperative paradigms*, when a coordination from among non-competitive agents exists and *Competitive paradigms*, in which some rules for the behavior of competitive agents are defined (Weiss, 1999).

In order to follow their own objectives, agents are interacting and communicating among themselves. Communication capabilities consist of the ability to send and receive messages. This is required to ensure a coordination mechanism among agents, in order to prevent and avoid conflicts among agents' accessing resources or achieving objectives.

Implementing a cooperation-based paradigm means employing planning approaches to reduce resource contention and to ensure the achievement of global objectives. No mediator is involved. In this case, each

agent is self-interested, meaning that the final solution may be the best for the single agent involved, but not for the group as a whole. These approaches can be distinguished into two main categories (Barbati et al., 2012):

- *Distributed approaches*, in which agents are endowed with self-organizing rules for resource sharing and goal pursuing.
- *Centralized approaches*, in which a mediator agent is assigned with the task of regulating and supervising agents' behaviors.

Since its first appearance in early 1970s, the exploration of the ABM literature has seen vigorous development, especially in the last decade owing to availability of various ABM software. This paper employs a bibliometric methodology that is geared towards a review of literature productivity, and an observation of the trends in ABM.

After defining agent-based models more closely, the paper is organized as follows. A bibliometric review of ABMs usage in scientific papers is presented in section 2. Then, the application of ABMs in chosen fields is exemplarily demonstrated in section 3. Finally, conclusions and some prospects for the future research are provided in section 4.

2. BIBLIOMETRIC REVIEW OF ABMs APPLICATION

In order to analyze the presence of ABMs in the scientific literature we have performed a search through the Thomson Reuters Web of Science (Thomson Reuters, 2016b) in Science Citation Index Expanded (SCI-EXPANDED) and Social Sciences Citation Index (SSCI) databases and collected data. The keywords we were looking for are:

"agent-based simulation" OR "agent-based model"

for the time interval 2000-2015, as there is an inconsiderable amount of published papers in previous years. The search was conducted for the *topic*, which includes: title, abstract, author and keywords in Web of Science (Thomson Reuters, 2016b).

As displayed in Table 1, we have collected data for 2902 papers. The increase in a number of papers per year is evident, which means the method is becoming more acknowledged. The number of ABM-related papers increased almost 30 times from 2000. until 2015, while total number of SCI-EXPANDED and SSCI papers increased only 1.77 times in the same time period. The biggest leap in ABM-related published papers occurred in period 2012-2013, from 294 to 380.

Table 1: Number of ABM-related and total SCI-EXPANDED & SSCI papers

Year	ABM Papers	Total SCI-EXPANDED & SSCI Papers
2000	15	1,099,828
2001	33	1,087,477
2002	30	1,132,596
2003	61	1,177,644
2004	72	1,272,284
2005	92	1,340,592
2006	116	1,399,016
2007	118	1,471,075
2008	137	1,553,662
2009	173	1,613,263
2010	227	1,650,449
2011	290	1,736,725
2012	294	1,820,086
2013	380	1,917,193
2014	415	1,942,001
2015	449	1,945,858
Total	**2902**	**24,159,749**

Those 2902 papers are published in 908 journals. In Table 2 we present 19 journals with at least 20 papers published in the observed period. The top contributor is the *Journal of Artificial Societies and Social Simulation* with 208 papers published. Since its first issue in 1998, it has been one of the leading references for readers interested in social simulation and the application of computer simulation in the social sciences. The list of journals shows a multidisciplinary interest in ABMs. In addition to journals that are expected to be on the list, journals specialized in Simulation and Modeling (*Journal of Artificial Societies and Social Simulation*, *Simulation Modelling Practice and Theory*, etc.), there are journals specialized in other scientific fields, like: Ecology (*Ecological Modelling*, *Environmental Modelling & Software*, etc.), Biology (*Journal of Theoretical Biology*), Economics (*Journal of Economic Dynamics and Control*, *Journal of Economic Interaction and Coordination*), etc.

Table 2: Journals accounting for at least 20 papers

Journal	Papers	Journal IF (2014)	IF Without Journal Self Cites (2014)	% IF Change Without Self Cites
Journal of Artificial Societies and Social Simulation	208	0.941	0.811	-13.82%
Physica A: Statistical Mechanics and its Applications	88	1.732	1.181	-31.81%
PLoS ONE	88	3.234	2.885	-10.79%
Journal of Theoretical Biology	62	2.116	1.868	-11.72%
Ecological Modelling	61	2.321	2.085	-10.17%
Environmental Modelling & Software	49	4.420	2.636	-40.36%
Advances in Complex Systems	45	0.968	0.920	-4.96%
SIMULATION: Transactions of The Society for Modeling and Simulation International	40	0.818	0.631	-22.86%
Simulation Modelling Practice and Theory	33	1.383	1.064	-23.07%
Computers, Environment and Urban Systems	32	1.537	1.349	-12.23%
Computational and Mathematical Organization Theory	24	0.840	0.740	-11.90%
Expert Systems With Applications	24	2.240	1.793	-19.96%
Journal of Economic Dynamics and Control	22	1.018	0.851	-16.40%
Journal of Economic Interaction and Coordination	22	0.962	0.807	-16.11%
Energy Policy	21	2.575	2.106	-18.21%
Physical Review E	21	2.288	1.778	-22.29%
Environment and Planning B: Planning and Design	20	0.983	0.941	-4.27%
Journal of Economic Behavior & Organization	20	1.297	1.154	-11.03%
Journal of Simulation	20	0.580	0.500	-13.79%

Table 2 also reports impact factor (IF), IF without journal self-citations, and percentage of change in IF after the self-citations have been excluded. Data about journals and IF is collected from Tomson Reuters InCites™ (Thomson Reuters, 2016a). We can see that the journal with the highest IF (4.420) is *Environmental Modelling & Software*, which is also the journal with the highest decrease in IF after the self-citations were excluded (-40.36%). Journal that stands out with high IF (3.234) and a small percentage of change after the self-citations have been excluded (-10.79%) is *PloS ONE*. We can also see that there are journals with IF lower than 1 (*Environment and Planning B: Planning* and *Design and Advances in Complex Systems*) whose IF did not drastically change after excluding self-citations - change is lower than 5%.

Additional analysis of citations is conducted using network visualization and exploration software Gephi (Gephi, 2016). Total citation count for the selected journals has been collected from the Tomson Reuters InCites™ (Thomson Reuters, 2016a) for the period until 2014. The obtained results are displayed in Figure 1, where node size is determined by the percentage of self-citations specific journal has (number self-citations divided by a total number of citations). For example, it is noticeable that *Computers, Environment and Urban Systems* has lowest (5.56%) and *Environmental Modelling & Software* highest (20.48%) percentage of self-citations. The weight of the line is defined as the sum of percentages of citations acquired from the other observed journal. For example, *Physica A: Statistical Mechanics and its Applications* got 1015 citations from *Physical Review E* and has 16,974 citations in total, which means *Physica A: Statistical Mechanics and its Applications* got 5.98% of citations from *Physical Review E*. In the other direction, *Physical Review E* got 2948 citations from *Physica A: Statistical Mechanics and its Applications* and has

81,746 in total, which means *Physical Review E* got 3.61% of citations from *Physica A: Statistical Mechanics and its Applications.* The weight of line is determined by the sum of these percentages (5.98% + 3.61%). The size of the arrow is defined separately for each side in a similar manner. For example, the two-sided arrow between *Physical Review E* and *Physica A: Statistical Mechanics and its Applications* means that journals have cited each other quite often. Connection between *Physica A: Statistical Mechanics and its Applications* and *Advances in Complex Systems* stands out. Namely, *Advances in Complex Systems* is very frequently cited by *Physica A: Statistical Mechanics and its Applications* (8.19% of total citations *Advances in Complex Systems* received are from *Physica A: Statistical Mechanics and its Applications*). Similarly, we can analyze the remaining connections between journals.

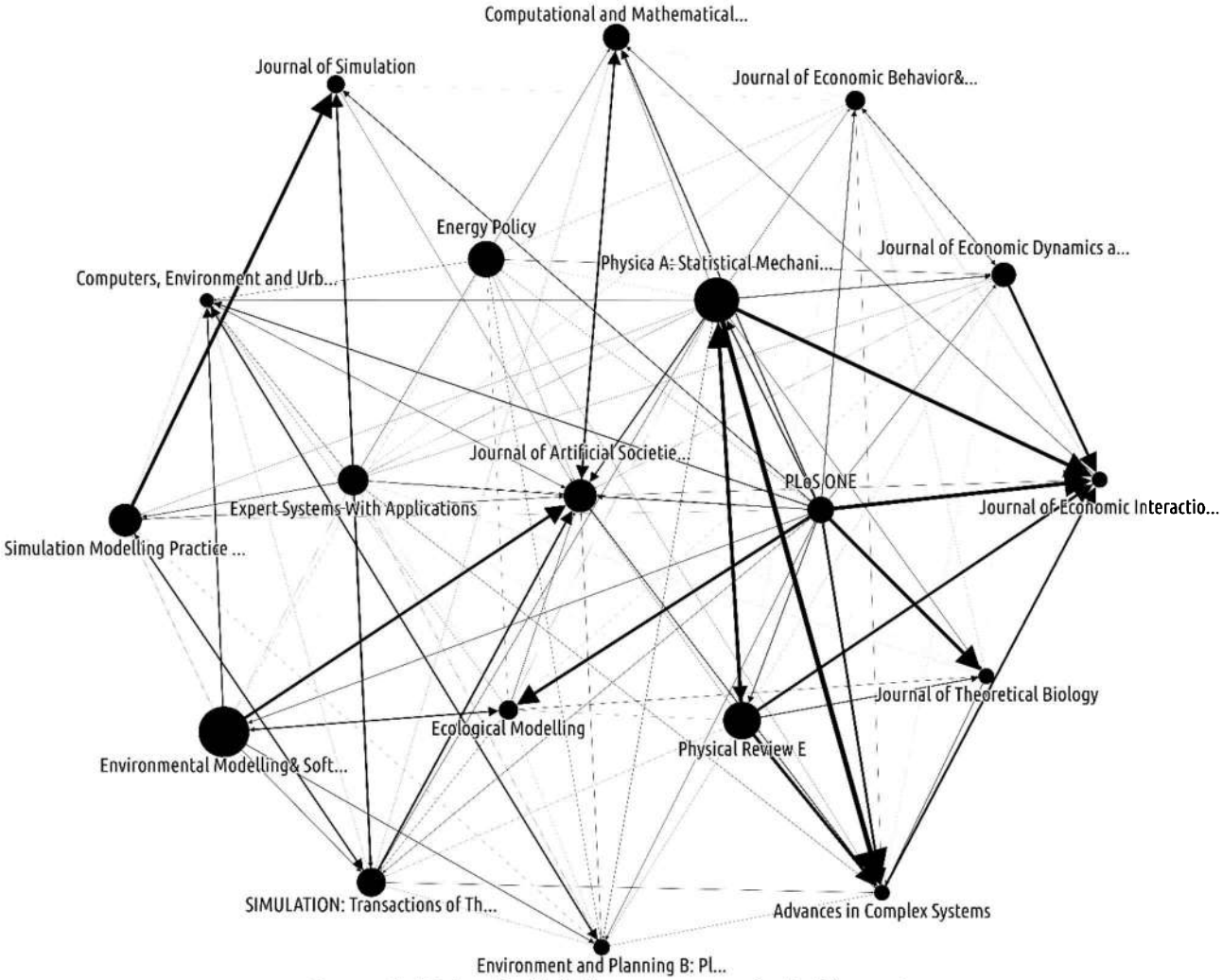


Figure 1: Network of citations among selected journals

Analyzing the research area retreived from Web of Science (Thomson Reuters, 2016b), ABMs are applied in (Table 3), we can provide one more evidence that ABMs are suitable for solving various problems. It is particularly interesting that *Environmental Sciences & Ecology* and *Business & Economics* are among areas with most frequent ABMs usage, just behind IT related areas. In the next paper section, we presented some of the applications in these fields.

Table 3: Research area

Research Area	Papers	Research Area	Papers
Computer Science	635	Life Sciences & Biomedicine - Other Topics	140
Environmental Sciences & Ecology	441	Geography	101
Engineering	396	Transportation	86
Business & Economics	364	Mathematical Methods In Social Sciences	63
Social Sciences - Other Topics	254	Public, Environmental & Occupational Health	63
Science & Technology - Other Topics	219	Biochemistry & Molecular Biology	55
Physics	212	Energy & Fuels	55

Research Area	Papers	Research Area	Papers
Mathematics	202	Sociology	53
Operations Research & Management Science	185	Information Science & Library Science	52
Mathematical & Computational Biology	165	Psychology	51

We also wanted to place attention on the keywords authors chose to best represent their work (Table 4), the most frequent keywords used in the observed papers. Disregarding the presumed ones (such as *model*, *systems*, *simulation*, etc.), other keywords are describing the field of application (such as *management*, *social networks*, etc.). Another keyword which is very popular in recent years is *optimization* (Barbati et al., 2012).

Table 4: Most used keywords

Keyword	Papers	Keyword	Papers
Dynamics	321	Agent-based simulation	65
Model	301	Strategies	65
Systems	268	Performance	63
Simulation	214	Information	62
Behavior	212	Transmission	60
Management	141	Social networks	59
Evolution	138	Impact	58
Networks	135	System	56
Models	123	Competition	55
Agent-based model	96	Diffusion	55
Cooperation	79	Decision-making	54
Patterns	79	Optimization	51
Growth	73	Framework	50
Land-use	69	Market	50
Design	67		

3. APPLICATION EXAMPLES

The applicability of the agent-based models and agent-based simulation is exemplarily demonstrated in two fields which were found interesting: optimization problems and analysis of customer behaviour.

3.1. Optimization problems

Agent-based approaches are successfully employed to tackle a broad class of scheduling, transportation, supply chain planning, and other optimization problems (Barbati et al., 2012). Some of the attention-grabbing examples are presented in the following research papers.

Böcker, Lind, and Zirkler (2001) presented the scheduling system for railway transport system train coupling and sharing (TCS). This scheduling system includes the planning of travel units and the optimization of solutions. The usage of ABM allows planning in a real-time scenario. The initially defined solution is then optimized by a simulated trading approach.

Fischer and Gehring (2005) used ABM as a supporting system for planning transshipments of imported finished vehicles via a seaport. The focus was on storage allocation, i.e. allocation of parking areas for the temporary storage of vehicles and on deployment scheduling, i.e. the allocation of drivers to the vehicles that have to be moved in the terminal area. Planning tasks, which is usually carried out by different operators, are assigned to two different agent types: a further agent and the coordinator agent, who is responsible for combining the local sub-plans into a global plan in such a way that the demand for drivers is minimized and balanced.

An ABM, which can simulate a supply chain, was developed by Liang and Huang (2006). The main purpose of their model is to coordinate all entities of the supply chain and minimize total cost while every entity may

use different inventory system. Two types of agents are employed: control agents (each echelon has agents of this type) and demand forecast agents. The control agent collects historical demand data and strategies from managers and aims at building rule-base for supply chain management. The demand forecast agent, which communicates with control agents, is using a genetic algorithm (GA) to forecast each echelon's demand and minimize the total cost for the entire supply chain.

3.2. Analysis of customer behaviour

Consumer behavior research is a multidisciplinary phenomenon which involves various areas: psychology, marketing, sociology, economics, and engineering (Zhang & Zhang, 2007). The process in which consumers make their purchase decisions has been of great interest to researchers and practitioners for a long time (Burnett & Lunsford, 1994). Interactions among consumers and the purchase decision-making process generate market dynamics, such as the decoy effect and lock-in. Research into consumers' purchase decision-making and interactions increases the understanding of market dynamics. Traditional studies on consumer decision patterns, such as data mining, focus on using static equilibrium-based mathematical and statistical techniques to model consumers' socio-demographic and behavioral data (Zhang & Zhang, 2007). However, three types of data exist regarding consumer purchase decisions: 1) demographic data, 2) behavioral data, and 3) psychographic data (Rud, 2001). ABMs take a stage exactly here as they can incorporate all three types of data to analyze customers' behavior in more detail.

Cavoski and Markovic (2015) applied ABM to analyze customers' behaviour and online retailers' strategies. They identified three key segments of the observed system: the seller segment, the consumer segment, and the communication channel segment. Each of these segments are afterwards modeled as one type of agent population. Namely, they used empirical and theoretical data retrieved from the B2C online market for modelling agents. As a result of this modelling process, market managers are provided with the tool for investigating impacts of implementing their own business strategies (Marković, Čavoški, & Novović, 2016).

Another interesting application of ABM is in predicting electric vehicles market share evolution (Shafiei et al., 2012). The model has potential to analyze the effects of fuel prices, vehicles' attributes, consumer preferences, and social influences. The market share evolution of electric vehicles is observed in different scenarios. The results showed that electric vehicles can be successfully adopted in moderate and favorable scenarios. In adverse scenarios, like the ones with low gasoline price and the one with constantly high electronic vehicle price, support policies are needed (such as reduction in import taxes and infrastructure development for easier recharging).

4. CONCLUSION

In this work, the application of agent-based models is reviewed. Firstly, the comprehensive bibliometric data has been presented, including IF, IF without journal self-citations, and citation network analysis. We can conclude just at a glance that ABMs are successfully used in various fields of science. Moreover, their usage is growing with the course of time, from 15 papers published in 2000, this number increased to 449 in 2015. This proves that researchers from numerous scientific fields recognized the power of ABMs and are utilizing that power for solving the problems they run into.

Further in the paper, ABMs' applications are presented. The focus of the chosen papers was on solving optimization problems and analyzing the customer behaviour. It is proved that ABMs can be successfully employed to cope with scheduling, transportation, and supply chain optimization problems. Also, we provided insights on the implementation of ABMs for customer's behaviour and market share prediction.

The growing interest in agent-based modeling and agent-based simulation seems to be a very promising field of study. For this reason, future researches will be devoted to recognize and model other classes of problems using ABMs.

REFERENCES

Barbati, M., Bruno, G., & Genovese, A. (2012). Applications of agent-based models for optimization problems: A literature review. *Expert Systems with Applications*, *39*(5), 6020–6028. http://doi.org/10.1016/j.eswa.2011.12.015

Billari, F. C., Fent, T., Prskawetz, A., & Scheffran, J. (Eds.). (2006). *Agent-Based Computational Modelling*. Heidelberg: Physica-Verlag HD. http://doi.org/10.1007/3-7908-1721-X

Böcker, J., Lind, J., & Zirkler, B. (2001). Using a multi-agent approach to optimise the train coupling and sharing system. *European Journal of Operational Research*, *131*(2), 242–252.

http://doi.org/10.1016/S0377-2217(00)00124-7
Burnett, M. S., & Lunsford, D. A. (1994). Conceptualizing Guilt in the Consumer Decision-making Process. *Journal of Consumer Marketing*, *11*(3), 33–43. http://doi.org/10.1108/07363769410065454
Cavoski, S., & Markovic, A. (2015). Analysis of Customer Behaviour and Online Retailers Strategies Using the Agent-Based Simulation. *Management - Journal for Theory and Practice of Management*, *20*(77), 13–24. http://doi.org/10.7595/management.fon.2015.0031
Fischer, T., & Gehring, H. (2005). Planning vehicle transhipment in a seaport automobile terminal using a multi-agent system. *European Journal of Operational Research*, *166*(3), 726–740. http://doi.org/10.1016/j.ejor.2004.03.042
Gephi. (2016). Gephi - The Open Graph Viz Platform. Retrieved April 20, 2016, from https://gephi.org
Gerst, M. D., Wang, P., Roventini, A., Fagiolo, G., Dosi, G., Howarth, R. B., & Borsuk, M. E. (2013). Agent-based modeling of climate policy: An introduction to the ENGAGE multi-level model framework. *Environmental Modelling & Software*, *44*, 62–75. http://doi.org/10.1016/j.envsoft.2012.09.002
Kasaie, P., Andrews, J. R., Kelton, W. D., & Dowdy, D. W. (2014). Timing of Tuberculosis Transmission and the Impact of Household Contact Tracing. An Agent-based Simulation Model. *American Journal of Respiratory and Critical Care Medicine*, *189*(7), 845–852. http://doi.org/10.1164/rccm.201310-1846OC
Liang, W.-Y., & Huang, C.-C. (2006). Agent-based demand forecast in multi-echelon supply chain. *Decision Support Systems*, *42*(1), 390–407. http://doi.org/10.1016/j.dss.2005.01.009
Marković, A., Čavoški, S., & Novović, A. (2016). Agent-Based Model for Analysis of Stakeholders behaviour on B2C E-Markets. In *35th International Conference on Organizational Science Development* 576–589. Portorož.
Nikolopoulou, A., & Ierapetritou, M. G. (2012). Hybrid simulation based optimization approach for supply chain management. *Computers & Chemical Engineering*, *47*, 183–193. http://doi.org/10.1016/j.compchemeng.2012.06.045
Rebaudo, F., & Dangles, O. (2013). An agent-based modeling framework for integrated pest management dissemination programs. *Environmental Modelling & Software*, *45*, 141–149. http://doi.org/10.1016/j.envsoft.2012.06.014
Rud, O. (2001). *Data Mining Cookbook: Modeling Data for Marketing, Risk, and Customer Relationship Management*. New Yourk: John Wiley & Sons, Inc.
Shafiei, E., Thorkelsson, H., Ásgeirsson, E. I., Davidsdottir, B., Raberto, M., & Stefansson, H. (2012). An agent-based modeling approach to predict the evolution of market share of electric vehicles: A case study from Iceland. *Technological Forecasting and Social Change*, *79*(9), 1638–1653. http://doi.org/10.1016/j.techfore.2012.05.011
Thomson Reuters. (2016a). InCites™. Retrieved April 20, 2016, from https://incites.thomsonreuters.com
Thomson Reuters. (2016b). Web of Science. Retrieved April 14, 2016, from https://apps.webofknowledge.com
Weiss, G. (1999). *Multiagent systems: a modern approach to distributed artificial intelligence*. Cambridge: MIT Press.
Wooldridge, M., & Jennings, N. R. (1995). Intelligent agents: theory and practice. *The Knowledge Engineering Review*, *10*(02), 115–152. http://doi.org/10.1017/S0269888900008122
Zhang, T., & Zhang, D. (2007). Agent-based simulation of consumer purchase decision-making and the decoy effect. *Journal of Business Research*, *60*(8), 912–922. http://doi.org/10.1016/j.jbusres.2007.02.006

THE INFLUENCE OF EDUCATIONAL DEVELOPMENT INDICATORS ON GRADUATES' EMPLOYMENT RATES

Ana Bjelaković[1], Marina Dobrota*[1]
[1]University of Belgrade, Faculty of Organizational Sciences, Serbia
*Corresponding author, e-mail: dobrota.marina@fon.bg.ac.rs

Abstract: *Education as one of the fundamental factors of the development improves the quality of life and leads to broad social benefits to individuals and society. It has a major impact on employment prospects. Economic development is impossible without a substantial investment in human capital. This paper investigates the role of the education system in employment. We determined a set of non-financial and financial indicators of educational development as explanatory factors. To examine the correlation between proposed factors and the employment rate of recent graduates, backwards multiple linear regression analysis was conducted. Our findings suggest that we have both financial and non-financial indicators influencing the employment rates in the final model. The most influential non-financial indicators were those that measure a number of young people that continued their education and foreign languages spoken by the nation while the financial factors were public expenditure on education and annual expenditure per student.*

Keywords*: education, development, employment, human capital*

1. INTRODUCTION

The population is continuously progressing and boosting throughout observation and learning, and this fact makes education and lifelong learning the major segments of human development (Dobrota & Benkovic, 2014; Dobrota, Martic, Bulajic, & Jeremic, 2015; Dobrota, Savic, & Bulajic, 2015). Being as important as it is, education has been a main topic of a number of scientific research (Andjelkovic Labrovic, Bijelic, & Milosavljevic, 2014; Benkovic & Dobrota, 2012; Dobrota, Savic, et al., 2015; Radenkovic, Despotovic Zrakic, Bogdanovic, Barac, & Labus, 2014). According to Hirsto, Lampinen, and Syrjakari (2013), in the field of educational development, many different concepts have either been used interchangeably or to focus on different aspects of development. Early research originally examined key developments affecting higher education worldwide and patterns in higher education development (Altbach, 2003). More than ever before, education has become a lifelong course in which individuals proceed to learn in formal and informal environments throughout their lives (Blossfeld, Roßbach, & von Maurice, 2011; Dobrota, Jeremić, Bulajić, & Radojičić, 2015; Dobrota, Savic, et al., 2015; Fleming, 2011; Nguyen & Walker, 2016; Radenkovic et al., 2014; Roche, 2015; Volles, 2016).

Education correlates strongly with most important social and economic outcomes (Hout, 2012). The belief that education is an engine of growth rests on the quality and quantity of education in any country (Horvat, Dobrota, Krsmanovic, & Cudanov, 2015; Horvat, Krsmanovic, Dobrota, & Cudanov, 2013; Lutz & KC, 2011). Further policy reforms and changes in higher education systems have become top national priorities, as governments in several countries embrace the notion that higher education is a key component of their efforts towards economic and social development (Chapman & Miric, 2009). Educational systems are expected to boost the society in various ways through the deployment of different educational models, on primary and secondary, but especially tertiary level. Higher education models are various, and for a new model to contribute something novel, it must have the potential to move educational practice and research forward in ways that improve teaching and learning experiences and outcomes (Benkovic & Dobrota, 2012; Dobrota & Benkovic, 2014; Knewstubb, 2016).

Theories have proved that formal education is necessary to improve the production capacity of a nation and discusses the rationality behind investment in human capital (Olaniyan & Okemakinde, 2008). Education has a substantial impact on labor market outcomes such as earnings and employment, as well as non-market outcomes such as health, longevity, civic participation, and even criminal activity (Oreopoulos & Salvanes, 2011). The primary focus of the paper is examining the relations between the educational system features on one hand, and earnings and employment as a major factor of social development and well-being on the other.

It is well-known that the education has a major influence on earnings and employment (Blundell, Dearden, Goodman, & Reed, 1997; P. Brown, 1995; Evans, 2016; Purcell & Quinn, 1996; Waters, 2009; Weiss, Klein,

& Grauenhorst, 2014). For example, Brown and Sessions (1998) debate that, regardless of whether schooling signals or augments productivity, the correlation between education and earnings renders the enhancement of lifetime earnings and, as such, may represent a good investment for individual workers. However, the path from a pupil or a student to an employee is not always so mere. According to Charles (2015), the transition from higher education to employment requires a pre-professionalization, which is characterized by the dominant role of professional skills and their incorporation into the structure of initial higher education. This mechanism is explained by the persistence of an idealized conception of "matching" that still profoundly marks the relations between education and employment (Charles, 2015). The question finally arises as to whether or not a student simply needs a Ph.D. diploma in order to be a dominant employee candidate in a private sector (Pedersen, 2016).

In the course of previous studies on education and employment, the goal of this study was to show which indicators of the educational development have a significant impact on the employment rate of recent graduates. The research data were obtained from an accessible dataset Eurostat (Eurostat, 2016) that includes levels of educational development and structure based on individual criteria. In the following section, we defined the methodology and indicators that were used. This is followed by a presentation and discussion of the results. Finally, a conclusion was given.

2. METHODOLOGY

In this article, the main goal was to determine whether there exists and what is the strength and form of the relationship between various educational indicators and employment rates of recent graduates. For this purpose, twelve different criteria were chosen to determine a country's educational structure and development. These are (Eurostat, 2016):

Non-financial indicators of the educational structure:

- *Employment rates of recent graduates* - the employment rates of persons aged 20 to 34.The indicator is calculated based on data from the EU Labour Force Survey.
- *School expectancy* - expected years of education over a lifetime (this type of estimate is accurate if current patterns of enrolment continue on the same trend in the future).
- *18-year-olds in education* - the percentage of all 18-year-olds who are still in any kind of school (all ISCED levels). It gives an indication of the number of young people who have not abandoned their efforts to improve their skills through initial education, and it includes both those who had a regular education career without any delays as well as those who are continuing even if they had to repeat some steps in the past.
- *Mobility of students in Europe* - the incoming students and outgoing students for each country, using the figures provided by the host country on foreign students enrolled in tertiary education by nationality. The lack of data on the distribution of students by nationality in some countries leads to underestimation of the values.
- *Share of women among tertiary students* - the percentage of women among all students in tertiary education, regardless of the field of education they are in.
- *Pupil teacher ratio in primary education* - calculated by dividing the number of full-time equivalent pupils by the number of full-time equivalent teachers teaching at ISCED level 1. Only teachers in service (including special education teachers) are taken into account.
- *Foreign languages learnt per pupil* - average number of foreign languages learned per pupil in secondary education. A foreign language is recognized as such in the curriculum or other official documents relating to education in the country.
- *Pupils learning English* - the percentage of all pupils in upper secondary education who are learning English as a foreign language. It only covers general and not vocational education in countries where English is described as a foreign language in the curriculum or other official document relating to education in the country.

The next five variables represent financial indicators of the educational structure

- *Annual expenditure on public and private educational institutions per student*
- *Private expenditure on education*
- *Annual expenditure on public and private educational institutions compared to GDP per capita*
- *Total public expenditure on education*
- *Public expenditure on education*

These variables show education funding of the public sector either by directly bearing the current and capital expenses of educational institutions (direct expenditure for educational institutions) or by supporting students and their families with scholarships and public loans, as well as by transferring public subsidies for educational activities to private firms or non-profit organizations (transfers to private households and firms). These financial indicators demonstrate the importance given to education in any particular country and the potential for its further development.

The main idea was to determine whether the employment rates of recent graduates depends on other listed variables, i.e. financial and non-financial indicators of educational development (Dobrota, Savic, et al., 2015). We used backwards multiple LS linear regression (Narula & Wellington, 1982; Rencher & Christensen, 2012; Seal, 1967) to create a model, which would automatically exclude non-significant variables from the observation (Gujarati, 2002). The original multivariate regression model is given by the following formula:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_k X_{ki} + \varepsilon_i \quad (1)$$

where Y_i is an i-th observation od the dependent variable Y, β_j is a j-th regression coefficient (j=1,…k), X_{ji} is an i-th observation for the j-th independent variable, and ε is a residual.

Employment rates of recent graduates was chosen as a dependent variable while other listed variables were chosen as independent explanatory variables.

3. RESULTS

Before presenting the multiple LS linear regression model, we examined and established the possible relationships among variables used in this research. First, we wanted to identify is whether there exists and what is the form of the dependency of Employment rates from some of the most specific indicators of educational development.

Figure 1 shows the dependency of the Employment rates of recent graduates from an explanatory variable Annual expenditure on public and private educational institutions per student.

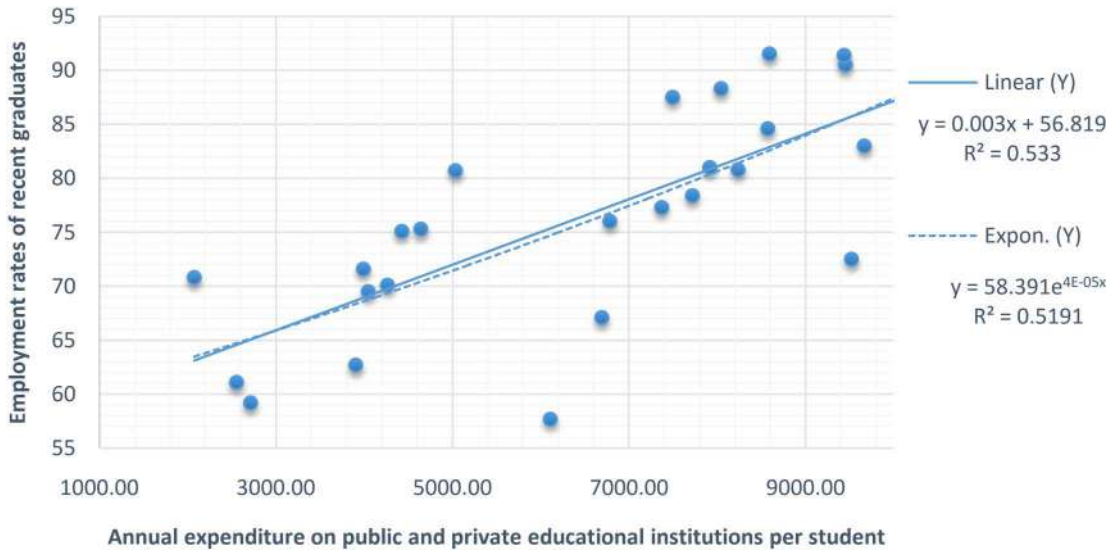


Figure 1: Relationship between Employment rates of recent graduates and Annual expenditure on public and private educational institutions per student

As can be seen in Figure 1, there is a mutual dependency between these two variables. We were able to extract a positive linear relationship from the given data, and the linear model is given in Figure 1. The Pearson's correlation coefficient r=0.73 ($p<0.001$), and the coefficient of determination R^2=0.533, indicating that 53.3% of the variability of Employment rates is explained by the model. For comparison, we also showed an exponential relationship between these two variables. Model is showed in Figure 1, where the coefficient of determination R^2=0.519, indicating a bit lower percent of explained variability.

Figure 2 shows the dependency of the Employment rates of recent graduates from an explanatory variable Public expenditure on education.

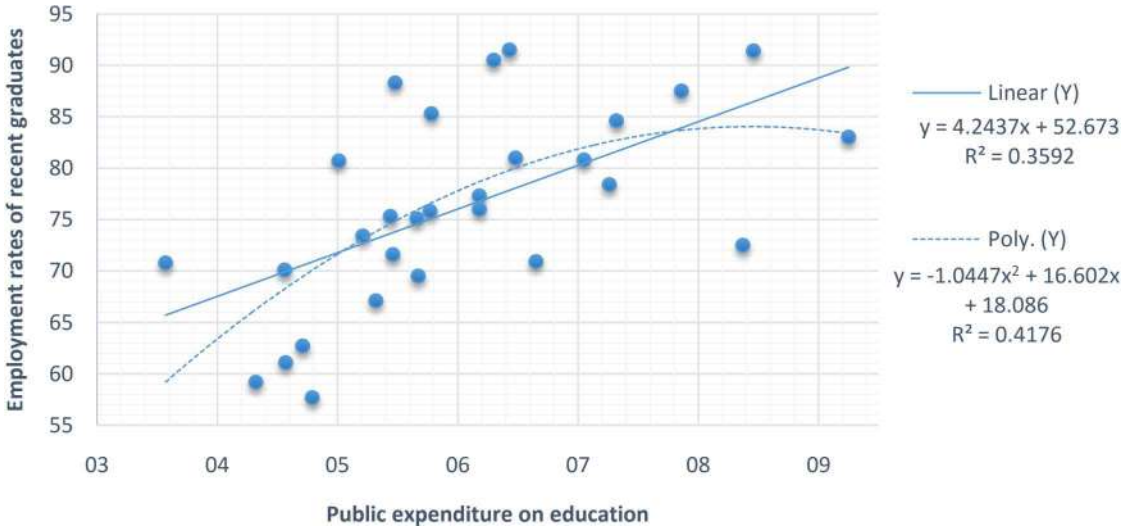


Figure 2: Relationship between Employment rates of recent graduates and Public expenditure on education

From Figure 2, we can see that there is a mutual dependency between these two variables and the linear model is given in the figure. We also extracted a positive linear relationship from the data and the Pearson's correlation coefficient r=0.599 (p=0.001). The coefficient of determination R^2=0.359, indicating that 35.9% of the variability of Employment rates is explained by the model. For comparison, here we showed a polynomial relationship between these two variables, given in Figure 2. In this model, the coefficient of determination R^2=0.417, indicating a higher percent of explained variability, having that the polynomial model could be a better fit for these data.

Figure 3 shows the dependency of the Employment rates of recent graduates from an explanatory variable Annual expenditure on public and private educational institutions compared to GDP per capita.

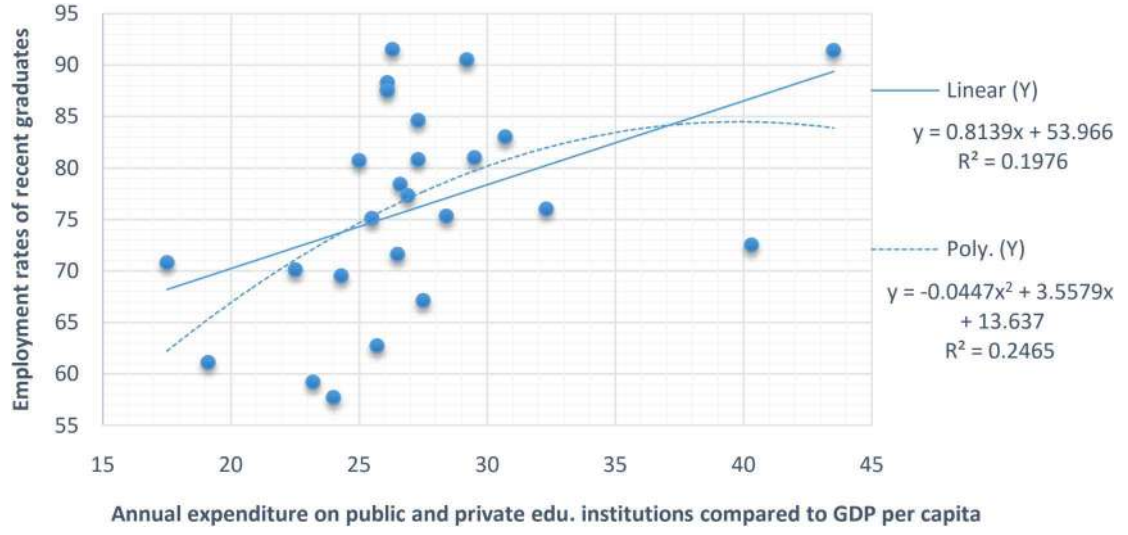


Figure 3: Relationship between Employment rates of recent graduates and Annual expenditure on public and private educational institutions compared to GDP per capita

From the Figure 3, a larger dispersion can be seen, which is also the characteristic of most of the other independent variables, especially non-financial. For the majority of financial independent variables, positive dependence is found, while this is not the case for non-financial variables (Table 1). In this model, we extracted a positive linear relationship where the Pearson correlation coefficient r=0.445 (p=0.026). The coefficient of determination R^2=0.197, indicating that only 19.7% of the variability of Employment rates is

explained by the model. For comparison, we also showed a polynomial relationship, given in Figure 3, for which coefficient of determination R^2=0.246, indicating a bit higher percent of explained variability.

Table 1 presents the Pearson's correlation coefficients between all the given variables. These are given in order better to understand the relationships and dependencies between data.

Table 1: Pearson's correlation coefficients between variables

Employment rates of recent graduates	ERR	SE	18ED	MEU	SWT	PTR	FL	PLE	AEE PP	PREE	AEE GDP	TPEE
School expectancy	.221											
18-year-olds in education	-.051	.770**										
Mobility of students in Europe	-.104	-.008	.097									
Share of women among tertiary students	-.118	.439*	.407*	-.402*								
Pupil teacher ratio in primary education	-.211	-.156	-.123	.346	-.121							
Foreign languages learnt per pupil	.092	-.294	-.039	-.129	-.194	-.277						
Pupils learning English	-.179	-.056	.121	.121	-.077	.490*	-.023					
Annual expenditure on public and private educational institutions per pupil student	.730**	.034	-.342	-.070	-.287	-.413*	.043	-.428*				
Private expenditure on education	.195	-.308	-.542**	.057	-.230	.107	-.088	.000	.276			
Annual expenditure on public and private educational institutions compared to GDP per capita	.445*	-.285	-.598**	-.158	-.094	-.344	.100	-.200	.603**	.664**		
Total public expenditure on education	.093	.017	-.127	.512**	-.473**	.364	-.262	.184	.186	.218	-.097	
Public expenditure on education	.599**	-.022	-.277	-.126	-.071	-.439**	.278	-.304	.839**	.284	.700**	-.114

*p<0.05, **p<0.01

Table 2 presents the original multiple linear regression model.

Table 2: The original multiple linear regression model

Predictors[1]	M	SD	B	SE	Beta	95%CI B	
Intercept			64.188	43.204		-33.546	161.923
School expectancy	17.573	1.5848	-.048	1.846	-.008	-4.224	4.128
18-year-olds in education	81.227	16.2219	.250	.229	.441	-.268	.768
Mobility of students in Europe	18.56	21.100	-.049	.108	-.112	-.294	.196
Share of women among tertiary students	55.805	3.6624	.095	1.074	.038	-2.333	2.524
Pupil teacher ratio in primary education	14.041	2.8811	.382	.687	.120	-1.173	1.937
Foreign languages learnt per pupil	1.655	.3334	10.423	5.530	.378	-2.088	22.933
Pupils learning English	93.877	8.7026	-.422	.254	-.399	-.996	.153
Annual expenditure on public and private educational institutions per student	6483.514	2407.889	.006*	.002	1.701	.002	.011
Private expenditure on education	.6323	.36810	-3.880	7.929	-.155	-21.815	14.056
Annual expenditure on public and private educational institutions compared to GDP per capita	27.668	5.4817	.089	1.002	.053	-2.178	2.356
Total public expenditure on education	21183.282	32893.378	-3.922E-6	.000	-.014	.000	.000
Public expenditure on education	5.675	1.4605	-6.293	3.515	-1.000	-14.245	1.658
R^2	0.553						
F	3.162*						

*p<0.05, **p<0.01
[1]Dependent variable: Employment rates of recent graduates

In the original model, all of the variables listed in section 2 were included in the analysis. From Table 2 it can be seen that, when combining independent variables in this way, only Annual expenditure on public and

private educational institutions per student significantly influences the dependent variable Employment rates of recent graduates. All other variables have significance larger than 0.05. With the coefficient of determination R^2=0.553, the model reveals that 55.3% of the variability of Employment rates of recent graduates is explained by the given combination of explanatory variables. The whole model is significant at 0.05 level of significance. The model also exhibits a large level of multicollinearity.

Table 3 presents the reduced backwards multiple linear regression model. This model was used to exclude the non-significant variables from the model, step by step automatically, and thus create the model that fits the given data in a best possible way. The method performed eight continuous iterations until the final model was obtained.

Table 3: The reduced backwards multiple linear regression model

Predictors[1]	**M**	**SD**	**B**	**SE**	**Beta**	**95%CI B**	
Intercept			63.335	18.131		24.899	101.772
18-year-olds in education	81.227	16.2219	.246**	.078	.434	.081	.411
Foreign languages learnt per pupil	1.655	.3334	10.416*	4.181	.378	1.552	19.280
Pupils learning English	93.877	8.7026	-.313*	.157	-.297	-.646	.019
Annual expenditure on public and private educational institutions per student	6483.514	2407.889	.006**	.001	1.573	.004	.008
Public expenditure on education	5.675	1.4605	-5.752*	2.028	-.913	-10.051	-1.452
R^2	0.705						
F	11.059**						

*p<0.05, **p<0.01
[1]Dependent variable: Employment rates of recent graduates

The reduced model includes only five, of originally eleven independent variables. Among them, we have two financial and three non-financial indicators influencing the Employment rate of recent graduates. The most influential non-financial indicators were 18-year-olds in education, Foreign languages learnt per pupil, and Pupils learning English; the most influential financial indicators are Annual expenditure on public and private educational institutions per student and Public expenditure on education. Among them, 18-year-olds in education and Annual expenditure on public and private educational institutions per student are significant on 0.01 level of significance while others are on 0.05 level of significance. The most significant absolute influence has Annual expenditure on public and private educational institutions per student, followed by Public expenditure on education, and then 18-year-olds in education, Foreign languages learnt per pupil, and Pupils learning English respectively, which can be seen from the column Beta in Table 3. The estimated model is presented as follows in the given formula:

$$\hat{Y} = 63.335 + 0.246X_1 + 10.416X_2 - 0.313X_3 + 0.006X_4 - 5.752X_5 \quad (2)$$

where Y is the dependent variable Employment rates of recent graduates and X_1 to X_5 are 18-year-olds in education, Foreign languages learnt per pupil, Pupils learning English, Annual expenditure on public and private educational institutions per student, and Public expenditure on education, respectively. With the coefficient of determination R^2=0.705, the model reveals that 70.5% of the variability of Employment rates of recent graduates is explained by the given combination of explanatory variables. The whole model is significant at 0.01 level of significance.

4. CONCLUSION

Under the influence of the Human Capital theory, which elaborated on the functions of education in promoting employment and increasing employment incomes (Schultz, 1961), many countries devoted major efforts to educational development in the 1960s and 1970s (Chen & Wu, 2007). This paper investigates the influence of educational development indicators on the employment rate of recent graduates.

We extracted the 12 financial and non-financial indicators that served as explanatory factors in the least squares linear regression model. We used a backwards method to exclude non-significant variables from the model automatically. The final model was obtained after eight iterations. Our findings suggest that we have both financial and non-financial indicators influencing the employment rate of recent graduates in the final model. The most influential non-financial indicators were those that measure a number of young people that continued their education and foreign languages spoken by the nation while the financial factors were public expenditure on education and annual expenditure per student.

The given model explains 70.5% of the variability of graduates' employment rates. Accordingly, it is important to recognise that the employment does not depend solely on the educational development factors but from the series of other factors (Barnes & Brown, 2016), such as the area of employability, social conditions, but their individual features as well. For example, it is discussed that graduates of entrepreneurial education should be better prepared for the employment market and the rapidly changing economic environment, and thus, more productive, even in wage employment (Kucel, Róbert, Buil, & Masferrer, 2016). Future research directions might imply the further and more detailed analysis of influential factors on the employment.

REFERENCES

Altbach, P. G. (2003). Introduction to Higher Education theme issue on the Academic Profession in Central and Eastern Europe. *Higher Education*, *45*(4), 389–389. http://doi.org/10.1023/A:1023949808905

Andjelkovic Labrovic, J., Bijelic, A., & Milosavljevic, G. (2014). Mapping Students' Informal Learning Using Personal Learning Environment. *Management - Journal for Theory and Practice of Management*, *19*(71), 73–80. http://doi.org/10.7595/management.fon.2014.0009

Barnes, S.-A., & Brown, A. (2016). Stories of learning and their significance to future pathways and aspirations. *British Journal of Guidance & Counselling*, *44*(2), 233–242. http://doi.org/10.1080/03069885.2016.1145194

Benkovic, S., & Dobrota, M. (2012). Application Of Teaching Methods And Techniques AT Serbian Universities: Progress Over Time. *Management - Journal for Theory and Practice of Management*, *17*(63), 35–44. http://doi.org/10.7595/management.fon.2012.0007

Blossfeld, H.-P., Roßbach, H.-G., & von Maurice, J. (2011). *Education as a Lifelong Process*. New York: Springer.

Blundell, R., Dearden, L., Goodman, A., & Reed, H. (1997). *Higher education, employment and earnings in Britain*. London: The Institute for Fiscal Studies. http://doi.org/10.1920/re.ifs.1997.0052

Brown, P. (1995). Cultural Capital and Social Exclusion: Some Observations on Recent Trends in Education, Employment and the Labour Market. *Work, Employment & Society*, *9*(1), 29–51. http://doi.org/10.1177/095001709591002

Brown, S., & Sessions, J. (1998). Education, Employment Status and Earnings: A Comparative Test of the Strong Screening Hypothesis. *Scottish Journal of Political Economy*, *45*(5), 586–591. http://doi.org/10.1111/1467-9485.00113

Chapman, D. W., & Miric, S. L. (2009). Education Quality in the Middle East. *International Review of Education*, *55*(4), 311–344. http://doi.org/10.1007/s11159-009-9132-5

Charles, N. (2015). When Training Is Not Enough: Preparing Students for Employment in England, France and Sweden. *Sociologie Du Travail*, *57*, e1–e21. http://doi.org/10.1016/j.soctra.2015.09.008

Chen, Z., & Wu, Y. (2007). The relationship between education and employment: A theoretical analysis and empirical test. *Frontiers of Economics in China*, *2*(2), 187–211. http://doi.org/10.1007/s11459-007-0010-4

Dobrota, M., & Benkovic, S. (2014). Comparing 'Ex-Cathedra' and IT-Supported Teaching Methods and Techniques: Policy of Teaching Practice. *Croatian Journal of Education*, *16*(Sp.Ed.3), 91–108.

Dobrota, M., Jeremić, V., Bulajić, M., & Radojičić, Z. (2015). Uncertainty and Sensitivity Analyses of PISA Efficiency: Distance Based Analysis Approach. *Acta Polytechnica Hungarica*, *12*(3), 41–58.

Dobrota, M., Martic, M., Bulajic, M., & Jeremic, V. (2015). Two-phased composite I-distance indicator approach for evaluation of countries' information development. *Telecommunications Policy*, *39*(5), 406–420. http://doi.org/10.1016/j.telpol.2015.03.003

Dobrota, M., Savic, G., & Bulajic, M. (2015). A New Approach to the Evaluation of Countries' Educational Structure and Development: The European Study. *European Review*, *23*(04), 553–565. http://doi.org/10.1017/S1062798715000277

Eurostat. (2016). European statistics. Retrieved March 10, 2016, from http://ec.europa.eu/eurostat/web/main/home

Evans, C. (2016). Moving away or staying local: the role of locality in young people's "spatial horizons" and career aspirations. *Journal of Youth Studies*, *19*(4), 501–516. http://doi.org/10.1080/13676261.2015.1083955

Fleming, T. (2011). *Models of Lifelong Learning: An Overview*. Oxford University Press. http://doi.org/10.1093/oxfordhb/9780195390483.013.0018

Gujarati, D. (2002). *Basic Econometrics*. McGraw-Hill/Irwin.

Hirsto, L., Lampinen, M., & Syrjäkari, M. (2013). LEARNING OUTCOMES OF UNIVERSITY LECTURERS FROM A PROCESS-ORIENTED UNIVERSITY PEDAGOGICAL COURSE. *Trames. Journal of the Humanities and Social Sciences*, *17*(4), 347. http://doi.org/10.3176/tr.2013.4.03

Horvat, A., Dobrota, M., Krsmanovic, M., & Cudanov, M. (2015). Student perception of Moodle learning management system: a satisfaction and significance analysis. *Interactive Learning Environments*, *23*(4), 515–527. http://doi.org/10.1080/10494820.2013.788033

Horvat, A., Krsmanovic, M., Dobrota, M., & Cudanov, M. (2013). Students` Trust in Distance Learning:

Changes in Satisfaction and Significance. *Management - Journal for Theory and Practice of Management*, *18*(69), 47–54. http://doi.org/10.7595/management.fon.2013.0026
Hout, M. (2012). Social and Economic Returns to College Education in the United States. *Annual Review of Sociology*, *38*(1), 379–400. http://doi.org/10.1146/annurev.soc.012809.102503
Knewstubb, B. (2016). The learning–teaching nexus: modelling the learning–teaching relationship in higher education. *Studies in Higher Education*, *41*(3), 525–540. http://doi.org/10.1080/03075079.2014.934802
Kucel, A., Róbert, P., Buil, M., & Masferrer, N. (2016). Entrepreneurial Skills and Education-Job Matching of Higher Education Graduates. *European Journal of Education*, *51*(1), 73–89. http://doi.org/10.1111/ejed.12161
Lutz, W., & KC, S. (2011). Global Human Capital: Integrating Education and Population. *Science*, *333*(6042), 587–592. http://doi.org/10.1126/science.1206964
Narula, S. C., & Wellington, J. F. (1982). The Minimum Sum of Absolute Errors Regression: A State of the Art Survey. *International Statistical Review / Revue Internationale de Statistique*, *50*(3), 317. http://doi.org/10.2307/1402501
Nguyen, T. T. H., & Walker, M. (2016). Sustainable assessment for lifelong learning. *Assessment & Evaluation in Higher Education*, *41*(1), 97–111. http://doi.org/10.1080/02602938.2014.985632
Olaniyan, D. A., & Okemakinde, T. (2008). Human Capital Theory: Implications for Educational Development. *Pakistan Journal of Social Sciences*, *5*(5), 479–483.
Oreopoulos, P., & Salvanes, K. G. (2011). Priceless: The Nonpecuniary Benefits of Schooling. *Journal of Economic Perspectives*, *25*(1), 159–184. http://doi.org/10.1257/jep.25.1.159
Pedersen, H. S. (2016). Are PhDs winners or losers? Wage premiums for doctoral degrees in private sector employment. *Higher Education*, *71*(2), 269–287. http://doi.org/10.1007/s10734-015-9901-y
Purcell, K., & Quinn, J. (1996). Exploring the education-employment equation in hospitality management: a comparison of graduates and HNDs. *International Journal of Hospitality Management*, *15*(1), 51–68. http://doi.org/10.1016/0278-4319(96)00002-3
Radenkovic, B., Despotovic Zrakic, M., Bogdanovic, Z., Barac, D., & Labus, A. (2014). IT Education as an Opportunity for Uprising of Serbian Economy. *Management - Journal for Theory and Practice of Management*, *19*(71), 57–72. http://doi.org/10.7595/management.fon.2014.0014
Rencher, A., & Christensen, W. (2012). Chapter 10, Multivariate regression – Section 10.1, Introduction. In *Methods of Multivariate Analysis* (p. 19). John Wiley & Sons.
Roche, S. (2015). Of integration and disintegration: The “hows” and “whys” of lifelong learning in a rapidly changing world. *International Review of Education*, *61*(5), 577–583. http://doi.org/10.1007/s11159-015-9521-x
Schultz, T. W. (1961). Investment in human capital. *American Economic Review*, *51*(1), 1–17.
Seal, H. (1967). Studies in the History of Probability and Statistics. XV The historical development of the Gauss linear model. *Biometrika*, *54*(1-2), 1–24. http://doi.org/10.1093/biomet/54.1-2.1
Volles, N. (2016). Lifelong learning in the EU: changing conceptualisations, actors, and policies. *Studies in Higher Education*, *41*(2), 343–363. http://doi.org/10.1080/03075079.2014.927852
Waters, J. L. (2009). In Pursuit of Scarcity: Transnational Students, “Employability”, and the MBA. *Environment and Planning A*, *41*(8), 1865–1883. http://doi.org/10.1068/a40319
Weiss, F., Klein, M., & Grauenhorst, T. (2014). The effects of work experience during higher education on labour market entry: learning by doing or an entry ticket? *Work, Employment & Society*, *28*(5), 788–807. http://doi.org/10.1177/0950017013506772

IMPACT OF LARGE EXPORTERS' OWNERSHIP STRUCTURE ON THE GROWTH OF EXPORT IN SERBIA

Zoran Jeremić[1]

[1]Singidunum University, Faculty of Business Economics
*Corresponding author, e-mail: zjeremic@singidunum.ac.rs

Abstract: *In this paper, we will analyse 100 largest exporters in Serbia in 2014 primarily from the standpoint of ownership structure i.e. whether the exporting company was founded by a foreign or domestic legal entity/ person as well as whether it operates as a limited liability company or a joint stock company whose shares are traded on the Belgrade Stock Exchange. The ownership structure is analysed in order to determine the extent of foreign i.e. domestic private or state-owned capital involved in these companies. The aim is identify largest exporters among domestic companies in order to determine what industries they operate in and the group of companies they belong to, as it provide insight into which domestic companies that are competitive on the international market.*

Keywords: *export, industrial sectors, competitiveness, ownership structure*

1. INTRODUCTION

The significance of export in a small country with an impoverished market is undisputable along with strategic ambition to create a suitable environment for further development of export. Even though there is a general consensus among domestic public and in strategic documents with this statement, the practice shows the presence ofa series of questions which haven't been resolved and different views on how to achieve the proclaimed goal of strengthening export. High rate of consent on this goal is also evident among international organisations such as World Bank and IMF whose publications and documents prioritise growth of export in Serbia. The subject matter of this paper is analysis of the ownership structure of 100 largest exporters in Serbia, with special focus on exporters founded by domestic legal entities and natural persons in the form of joint stock companies, limited liability companies and sole proprietorships.

For the purpose of this analysis, a database was created on actual export and import of 100 largest exporting companies based on data available to Customs Administration and we processed their balance sheets and income statements based on data obtained from the Serbian Business Registers Agency. In order to ensure comparability of export data with data contained in balance sheets and income statements, amounts expressed in dinars were converted into euros by applying average annual exchange rate for income statement items and the exchange rate prevailing on the last day of the year for balance sheet items. Ownership structure was determined by using websites of Serbian Business Registers Agency and of the companies which are the subject matter of this analysis as well as the website of Belgrade Stock Exchange for the listed joint stock companies. Database covers the period from 2008 to 2014, with 2008 being regarded as the base year for analysis since it is the last year for which comprehensive data on companies' balances is still available, though the focus of analysis will be placed on 2014.

The group of top 100 exporters is relevant for our research because it had more than half of the share in the commodity export in 2014. Moreover, the share which top 100 exporters have in total export is continuously on the rise. While this share was 41% in 2008, in 2014 it grew to 55%. This group achieved total export equal to €6,203 million euros, total assets of €11,341 million euro, capital worth €4,745 million euro, operating income of €11,629 million euro, net profit of €716 million euro while the total number of their employees amounted to 68,690 people. These indicators show that this group certainly is not a relevant sample only in terms of exporting companies but also for analysing the state of Serbian economy. Aggregate data on 100 largest exporters are divided into three groups according to who is the majority shareholder: foreign company, domestic legal entity or natural person, or the state. After this, we analysed the share that each of these subgroups had in the total export of 100 largest exporters. What is particularly important is to identify the industrial sectors and groups they operate in, ratio of export and import and business performances of these companies over the observed period.

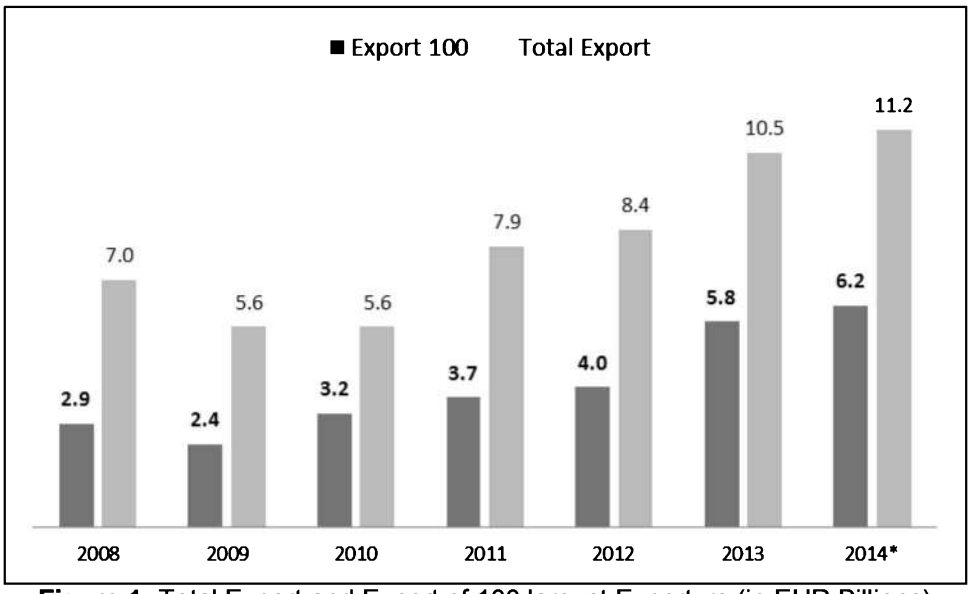


Figure 1: Total Export and Export of 100 largest Exporters (in EUR Billions)
Source: Republic of Serbia, Customs Administration, summarised by author

By observing the period between 2008 and 2014, we noted positive changes in the growth of export, export structure and the import coverage ratio. Export has recorded faster growth than import with a slightly positive change in terms of its structure. A certain number of new companies emerged on the market in the observed period primarily export-oriented with positive effect on the reindustrialisation, mainly drawn to this market by government subsidies and low labour costs. Simultaneously, some of the leading exporting companies recorded a dramatic downfall in their business at the time of economic crisis which resulted in the drop of export as well.

However, when it comes to export in 2014, the positive trends observed in the previous years were continued. By analysing the fluctuation of export among the 30 largest net exporters, it was observed that net exporters are mainly companies in the processing industry, primarily metal processing industry and electric power industry followed by agricultural production (maize, sugar) and by military industry on a smaller scale. Having in mind the rising trend in export recorded by the largest exporters, special attention should be paid to their analysis by answering the following question: Are there any potential "stars" among Serbian exporters which could contribute to faster growth of the country's export as had already happened in several other countries (see: Export stars...) particularly if such growth would imply integration of smaller domestic companies into their production chain instead of providing incentive for each company individually to enhance its export. What is worrying when it comes to large exporters is the fact that they are simultaneously large importers as well, and for this reason, it would be interesting to find out the group in which net export is predominant. It could be reasonably assumed that domestic companies are in advantage in respect of net export and thus their total effect on the country's economy is more useful,which is why this hypothesis will be tested here as well.

2. FOREIGN COMPANIES AMONG 100 LARGEST EXPORTERS

By dividing the largest exporters according to their country of origin into group of companies owned by foreign companies and exporters whose majority shareholders are domestic privately-owned or state-owned companies, we note a strong dominance of foreign countries both in terms of their number (63) and their share in the total export (77.1%). Foreign companies' share in the export realised by 100 largest exporters in 2014 was 77.1% i.e. € 4.8 billion euro, employing 49,313 workers i.e. 71.8% of the group's employees. This group also includes large net exporters, for example in the area of car spare parts industry, which came to Serbia primarily because of high government subsidies and low labour costs and partially due to presence of FIAT company. The next group includes home appliances and machine manufacturers – three Gorenje factories.

Table 1: Ownership structure of 100 largest exporters

Ownership structure	Number of exporters	of which: net exporters
Total number of exporters	100	67
a. Owned by foreign companies	63	40
b. Owned by domestic companies	30	20
c. Owned by state	7	7
of which in restructuring	4	4

Source: Republic of Serbia, Customs Administration, summarised by author

Though there had been plenty of off-target and unnecessary government subsidies, the effects are visible in cases where foreign investors oriented to exports and new technologies were attracted to Serbia. However, the issue here is that the economic climate was not further improved but, on the contrary, macroeconomic flows and the business conditions were dramatically aggravated so the subsidies were necessary to attract the investors because without such subsidies we would have obtained lesser level of foreign investments. However, attracting foreign investors with subsidies, as a compensation for poor economic environment, with employment of unqualified and poorly paid labour force, cannot be used as a permanent model to increase export and the solution should be sought in improvement of the business and investment climate and reduction of subsidies can then go hand in hand with such improvement.

Table 2: Export, Import (in EUR Millions) and Number of Employees

Companies	Export	Import	Net export	No. of empl.
a. Owned by foreign companies	4.780,1	5.828,7	-1.048,6	49.313
b. Owned by domestic companies	836,1	573,8	262,3	10.422
c. Owned by state	587,1	251,8	318,1	8.955
Total	6.203,3	6.654,3	-468,2	68.690

Source: Republic of Serbia, Customs Administration, and Agency for Business Registers, data processed by author

In addition to their high concentration among top 100 exporters, the growth of the group of 5 to 7 largest companies is conspicuous and they also record the largest growth of export. The general trend in export shows that the concentration of large companies is growing as they are more competitive and better prepared to face the international competition whereas smaller companies have issues with emerging on the foreign markets and maintaining their market position. Large exporters are also large importers, with third of exporters having higher import than export. These are vital facts. For this reason, we will identify the most significant net exporters, from the standpoint whether they are owned by foreign or domestic companies, as well as what industry they operate in. Net exporters namely have significantly higher contribution to the newly added value of gross domestic product and more significantly improve the country's balance of trade and the balance of payments.

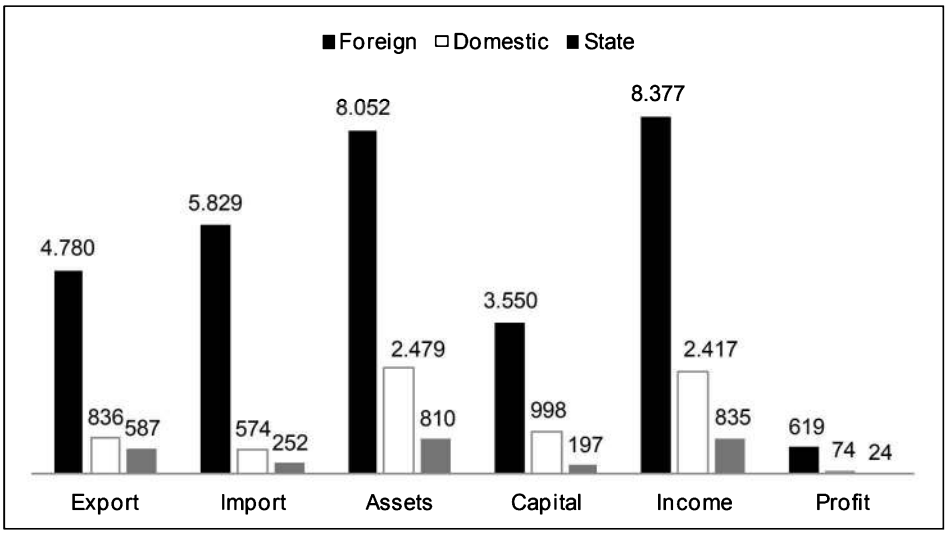


Figure 2: Foreign, Domestic and State-Owned Exporters (in EUR Millions)

Source: Republic of Serbia, Customs Administration, and Agency for Business Registers, data processed by author

3. COMPANIES OWNED BY DOMESTIC LEGAL ENTITIES AND NATURAL PERSONS

Out of 30 companies owned by domestic legal entities and natural persons which are among 100 largest exporters, 15 are agricultural produce processing companies (sugar beet, soya, oils, meat, animal feeds, and dairy products). This group also includes one company which is a successful metal-processing company, one furniture company and one bankrupt company while the rest are mainly involved in the export of primary agricultural products and in food import and processing for their own needs. So, export of primary and secondary agricultural products is dominant while export of other industrial products is on a minimum level. Largest agricultural produce processing companies include 4 sugar-processing companies, 4 fruit-processing companies, 2 animal-feed processing companies and one soya and one milk-processing company.The largest exporters were 4 sugar processing companies which are also the largest net exporters as import plays a very small role in their business. The structure dominated by agricultural produce manufacturing and processing companies reveals that it is difficult to be competitive and to penetrate the foreign markets in other non-agricultural industrial sectors. This observation particularly applies to the medium and small size companies, with 90% of them having recorded no export at all and having no potential to expand to foreign markets. They can find their chance for export if connected to exporting companies which are competitive on foreign markets.

4. STATE-OWNED EXPORTERS

The group of large exporters owned by the state is dominated by factories operating in military industry such as *Prvi Partizan*, Užice and *Zastava oružje*, Kragujevac. The broad list of exporters includes several factories which carry out their export via *Jugoimport SDRP*. Having in mind their export potential, we may expect further growth of export in military industry. HIP-Petrohemija is also an important exporter but for the time being there is no clear solution on sight for its strategic partner.

When it comes to export, *Železara Smederevo* is an ever-present topic. If the agreement concluded with the Chinese partner were to be realised, it would certainly be a huge encouragement for Serbian export and great relief on the country's budget. Železara can be profitable only if investments are oriented to highly processed products as was announced by the potential strategic partner. The balance sheet and income statement data of *RTB Bor* were not included in this analysis, but only export achieved by RTB Invest. The analysis of this company is far too complex since the data are controversial and non-transparent. However, it is certain that the recovery of *Železara Smederevo* and *RTB Bor* would largely depend on the future recovery and growth of the global economy i.e. on the increase of prices of export products since these companies cannot stay profitable with the prices remaining at the current level. Out of 7 companies owned by the state,

four are in the restructuring process and it remains uncertain whether a solution would be found for them before the deadline expires.

Table 3: Balance Sheet Items of 30 Largest Domestic Exporters (in EUR Millions)

Num.	Rank		Total Income		Net Income		No. of employees		ROE	
	in 100	Company name	2014	2013	2014	2013	2014	2013	2014	2013
1	23	SOJAPROTEIN AD BEČEJ	99	101	2.1	0.0	387	416	2.3%	0.0%
2	26	VICTORIAOIL AD ŠID	108	117	0.0	0.0	282	294	0.0%	0.0%
3	27	SUNOKO DOO NOVI SAD	154	206	6.0	45.5	469	478	4.3%	33.3%
4	38	MK COMMERCE DOO NOVI SAD	134	125	3.2	0.4	100	79	11.9%	18.3%
5	46	TE-TO, Senta	59	76	0.0	5.4	174	190	8.7%	1.9%
6	51	DOO ĆIRIĆ I SIN, SAKULE	32	25	1.7	1.2	19	18	13.8%	2.0%
7	33	UMKA D.O.O. UMKA	55	57	3.6	5.3	324	298	17.5%	14.2%
8	48	DELTA AGRAR, Beograd	168	180	2.6	6.6	273	278	0.0%	18.9%
9	63	FARMAKOM FINANCE, Šabac	0	5	0.0	0.5	0	43	6.6%	9.8%
10	79	MAT-AGRO, Novi Sad	58	41	1.4	0.3	13	10	2.1%	5.3%
11	71	ŠEĆERANA CRVENKA	53	63	0.0	6.4	207	210	10.9%	8.6%
12	89	ALTIVA DOO, BEOGRAD	0	17	0.0	0.2	0	7	24.5%	29.0%
13	93	AD FABRIKA ŠEĆERA, ŽABALJ	42	39	0.0	1.3	189	189	13.0%	7.3%
14	96	ELIXIR FOOD, Šabac	28	13	0.3	0.0	125	121	0.0%	5.8%
15	69	FORMA IDEALE,KRAGUJEVAC	56	56	3.4	3.4	1121	1042	15.7%	36.1%
16	47	AGROGLOBE, NOVI SAD	142	117	1.5	2.0	131	114	16.1%	16.7%
17	60	ALFA-PLAM AD, Vranje	40	36	6.5	3.5	718	742	3.2%	10.4%
18	88	GEBI DOO, PO ČANTAVIR	62	62	1.3	0.7	214	209	0.0%	21.9%
19	70	NECTAR DOO, BAČKA PALANK	68	69	1.5	5.1	638	667	12.7%	7.1%
20	57	DRENIK ND DOO BEOGRAD,	57	54	6.6	6.5	462	446	0.0%	0.0%
21	86	NOVKABEL AD, NOVI SAD	30	28	0.0	0.0	558	588	0.0%	0.0%
22	82	VICTORIA LOGISTIC DOO, NOVI	307	285	0.0	0.0	257	291	28.2%	60.9%
23	91	AD NEOPLANTA, NOVI SAD	72	60	3.2	2.0	742	720	0.0%	0.0%
24	36	SWISSLION DOO, BEOGRAD	75	83	5.9	1.3	873	879	0.0%	0.0%
25	43	PEŠTAN DOO, BUKOVIK	54	54	9.1	6.3	644	608	8.8%	4.9%
26	72	ELIXIR ZORKA, ŠABAC	88	46	4.0	2.0	221	201	0.0%	13.6%
27	90	DOO ALMEX, PANČEVO	85	88	6.0	8.4	272	233	12.2%	20.7%
28	66	PROMIST DOO,NOVI SAD	153	112	3.9	7.8	66	57	5.8%	3.6%
29	74	CENTRO-SPICE, Surčin	87	54	0	0	715	508	0.0%	8.8%
30	75	DELTA SPORT,BEOGRAD	51	58	0	0	228	348	1.3%	0.0%
		Total	2416.9	2326.6	73.8	122.3	10422.0	10284.0	7.2%	11.8%
		Source: Agency for Business Registers, data processed by autor								

Table 4: State-Owned Largest Exporters (in EUR Millions)

Num.	Rank	Company name	Export	Import	Income		Net Profit		No. of empl.	
	in 100		2014	2014	2014	2013	2014	2013	2014	2013
1	4	Železara, Smederevo	201	177	248	189	0	0	5.025	5.036
2	7	Hip-Petrohemij, Pančevo	148	21	257	377	0	0	1.738	1.787
3	18	RTB Invest	81	15	124	153	0	0	3	3
4	21	Jugoimport-SDPR JP Bgd.	67	12	73	83	6	5	379	362
5	29	Prvi Partizan, Užice	44	19	47	54	5	5	948	935
6	50	SMATSA DOO	29	8	86	82	12	9	862	882
7	94	Zastava oružje, Krag.	17	6	27	34	0	0	1.958	2.189
		TOTAL	587	258	863	973	24	19	10.913	11.194

Source: Republic of Serbia, Customs Administration, and Agency for Business Registers, data processed by author

5. CONCLUSION

Analysis of 100 largest exporters revealed several of their important characteristics: the export is dominated by companies in foreign ownership both in terms of their number and the value of their export. High concentration of export is also evident since 100 largest exporters had a share of 55% in total export in 2014. Even more important is the concentration of 5 to 7 largest exporters which continuously increase their export. Large exporters founded by foreign companies are also large importers with only 67 companies characterised by export exceeding import. In this respect, companies with domestic capital are more useful from the perspective of newly added value, with the most significant group of companies being agricultural product processing companies.

Out of 30 companies owned by domestic legal entities and natural persons which are among 100 largest exporters, 15 are agricultural products processing companies (sugar beet, soya, oils, meat, animal feeds, and dairy products). This group also includes one company which is a successful metal-processing company, one furniture company and one bankrupt company, while the rest are mainly involved in the export of primary agricultural products and in food import and processing for their own needs. So, export of primary and secondary agricultural products is dominant whereas export of other industrial productsison a minimum level. When we add 7 exporting companies owned by the state and operating in the ore-processing and military industry, we practically summarise the total export potential in domestic ownership. If Železara, RTB Bor and Petrohemija find their strategic partners in the future, which is a pre-condition for their survival, the state will retain the ownership only over the exporting companies operating in military industry. It should certainly be noted that the state is the co-owner of two large companies whose majority shareholder is a foreign company i.e. NIS a.d. Novi Sad and Air Serbia, and this model should not be excluded as a solution for the rest of the state-owned companies which are large exporters.

When it comes to private companies with domestic capital, they have a one third share in the top 100 exporters but their export value ranks them at the bottom portion of the list. In addition to that, they are mainly characterised by poorer business performance than the companies owned by well-known global companies. Even though some of our domestic companies have managed to come to the spotlight (Alfa plam), for domestic exporters it is an increasingly difficult battle to fight off foreign competition as those foreign companies bring with them knowledge, captured foreign markets to which they export their products, better corporate governance, bigger budgets for research and development and expert personnel. Domestic companies, however, are frequently exposed to unfair competition as their foreign competitors receive government subsidies just to come to Serbia. Domestic medium and small size enterprises are facing even greater difficulties to fight off comparative advantages of large foreign companies. What is an even bigger issue for them is to have sufficient demand and obtain necessary guarantees while they do not have neither financial nor development capacities to conquer foreign markets and oppose the mighty competitors. For this reason, further enlargement of companies may be expected in the upcoming period via takeover of some of current exporters by the stronger domestic companies but more so by foreign companies. The example of sugar processing companies that are large exporters sheds a lot of light on the issue. Due to fiercer competition on the European market, which is the main export market for Serbian sugar processing companies, further consolidation will be necessary because small sugar processing companies which are far removed from raw material base, falling behind in respect of technology while using more expensive energy sources, will not be able to survive on the market. Fruit and vegetable processing industry showed great possibility for export growth but it also requires well-thought through incentive for connecting primary production with domestic processing companies. This would greatly contribute to the growth of export, more even regional development and strengthening of domestic processing industry in the segment in which it can be competitive since Serbia is the global leader only in the quality and production of certain agricultural products such as raspberry, blackberry, apple... This sort of incentive does not mean that Serbia should not pay greatest attention to information industry and to the strengthening of high technology sectors but in this instance,the changes to the system of education would be of greater significance than financial incentives. Having in mind that export is a precondition for development and survival of a small and poor economy such as Serbian, it is vital to support exporting companies in all shapes and forms: by creating better business climate, by targeted incentives and assistance to industrial sectors in which Serbia can be competitive. The example of 100 largest exporters showed that the choice of competitive industrial sectors is very narrow. The most realistic chances lie in the development of processing industry based on high quality primary agricultural raw material. This is precisely where the added value is the highest as the share of import in this segment is the smallest, which makes 15 food processing companies also the largest net exporters. The wood and metal processing industries also have good chances for increasing export. In addition to food-

processing industry, we also have information industry where we can be competitive while the mining industry and tourism also provide good basis for further growth of export.

Attracting foreign investments with government subsidies as a compensation for poor economic climate, along with employment of unqualified and poorly paid labour forrce, cannot be used as a permanent model to increase export even though these incentives were necessary in current circumstances. Companies owned by foreign companies are primarily needed to bring new knowledge and new technologies and should employ domestic labour force having highest education and if they do not meet these criteria, any subsidies to such companies would be very questionable. The solution to the problem lies, naturally, in the continuous improvement of the business and investment climate and the reduction in subsidies can then go hand in hand with such improvement.

When it comes to changing the export structure, it is necessary to ensure that the main articles exported abroad are not agricultural produce such as maize, raspberries, apples and copper and such change in the export should be achieved systematically, having long-term goals in mind, in order to increase the share of highly processed products in export, which implies the use of new technologies,as well as to create economic climate which would favour net exporters.

REFERENCES

European Commission (2014), *Progress Report for Serbia*

Hausmann, R., Hwang, J. and Rodrik, D. (2006) *What You Export Matters.*Working Paper, Center for International Development, Harvard University,

Hesse, H. (2008). *Export Diversification and Economic Growth,* The World Bank On behalf of the Commission on Growth and Development,

Hidalgo, C., Klinger, B., Barbasi, A., and Hausmann, R. (2007)*: The Product Space Conditions the development of nations,* Science, 317-329.

Jeremić, Z., Milojevic, M. and Terzć, I. (2015): Business Performance of the Largest Exporters in Serbia During the Period 2008-2014, Ekonomika preduzeća, 5-6, 293-305.

Jeremić, Z., Milojevic, M. (2015): *The Most Successful Exporters and Importers in the Period 2008-2014,* The Economy and Finance Board 2015, Business Info Group, Kopaonik business forum, 6-37

Jeremic, Z., and group of authors. (2008)*: Stock Market in Serbia - Analysis of the Sector and 100 companies from the Belgrade Stock Exchange,* Chamber of Commerce of Serbia & Economist media group.

Serbia's Real Sector performance, CEVES, (2015),

Trbovic,A,Radosavljevic,G&Subotic,J.*,Competitivness Gap in Serbia's Metals and Electronics Industry,* Ekonomika preduzeća,(2012), 301- 315

The strategy to support the development of small and medium enterprises, entrepreneurship and competitiveness for the period from 2015.to 2020, Službeni glasnik RS 35/2015, 10

Food and Agriculture Organization of the United Nations, *The State of Agricultural Commodity Markets 2015/2016,* Rome 2015

World Bank (2012*), Republic of Serbia, The Road to Prosperity: Productivity and Exports,* Country Economic Memorandum,*22-43*

World Bank, (2014),*Rebalansing Serbia's Economy – Improving Competitiveness, Strengthening the Private Sector and Creating Jobs*

Why Invest in Serbia, Serbian Development Agency*, (2016), retrived from www.ras.gov.rs*

THE ALTERATION OF U21 RANKING METHODOLOGY: FROM EXPERT-DRIVEN TO DATA-DRIVEN WEIGHTING SCHEME

Milica Maričić*[1], Milica Bulajić[1], Marina Dobrota[1]
[1]University of Belgrade, Faculty of Organizational Sciences, Laboratory of Statistics
*Corresponding author, e-mail: milica.maricic@fon.bg.ac.rs

Abstract: *Indicator-based measurement of higher educational institutions and higher education systems' performance has started to play a significant role in defining national education policies and reforms. However, the issues surrounding the process of assessment and ranking are complex and far-reaching. Therefore, the controversy about ranking methodologies remains, whereas the critical pitfalls are the weighting scheme and the aggregation method. This study aims at tackling one of the two critical pitfalls by proposing a data-driven weighting scheme of the U21 ranking of national higher education systems (U21) using the Composite I-distance Indicator (CIDI) methodology. The CIDI weights proved to be more balanced and less oriented on the higher education systems' output. The presented approach and results can be a foundation for further academic research on university or higher education systems rankings that will be independent of subjectively formed weighting factors.*

Keywords*: U21 Ranking, I-distance method, CIDI Methodology, composite index, ranking of countries, higher education system*

1. INTRODUCTION

University rankings have long been employed, first on the national scale and later on a global scale (Marginson & van der Wende, 2007). In the last decade, the interest of various stakeholders for university rankings had risen. Firstly, the growing population of students and researchers needed insights on the quality performance of higher educational institutions (HEIs) (Saisana, D'Hombres, & Saltelli, 2011). On the other hand, the results of university rankings became a valuable source of information for policymakers. Ranks of national universities have become a symbol of national achievement and prestige, but also an engine of economic growth (Marginson & van der Wende, 2007). Therefore, university rankings can be used to trigger debates and policy reforms on a national level (Saisana & D'Hombres, 2008). Consequently, the rankings influence the higher educational institution's mission, strategy, recruitment procedures, and teaching process; i.e. nearly every aspect of the educational process (Harzing & Mijnhardt, 2015). Steadily, global university rankings are integrating into higher education, and there are various benefits from such occurrence. Just some of them are a positive impact on the number of potential applicants, opportunities to collaborate with the industry or with international higher educational institutions, additional government and non-government funding, and attraction of prospective students and academics.

Putting aside the potential benefits of the global university rankings, one should bear in mind the concerns the academic community has risen on this matter. Namely, academics have often criticized some of the rankings for their statistical inaccuracy (Huang, 2012), possible unfavourable impact on the overall performance of universities (Cheng, 2012), and for their influence on the educational policy (Hazelkorn, 2014). Saisana and D' Hombres (2008) outlined the fact that many ranking methodologies fail to follow accepted methodologic rules when selecting indicators and afterwards aggregating them into a composite index.

University rankings proved to be very useful, especially for government representatives in decision-making on the national level. However, users of university rankings, and especially the government, should have in mind the fact that although higher education system consists of separate institutions, it is necessary to have a holistic approach to ranking. Therefore, a new direction in the development of educational rankings emerged: the rankings of higher education systems. Martin and Sauvageot (2011) refer to the national higher education system as an integral part of the modern economy and social structure. As such, it should give as many people as possible a chance to gain analytical skills and technical knowledge that will enable them to respond to the competitive conditions in the labour market. Promotion and long-term investments in a small number of institutions will not raise the overall quality of the educational system. Also, a small number of institutions that are advancing faster cannot respond to the overall national needs for highly educated staff. In addition, it is necessary to show the public how their country is positioned on the global map of higher education systems (Williams et al., 2013).

For the foregoing reasons, in the last few years, additional efforts have been placed to devise a ranking of higher education systems. In 2012, one of them appeared: the Universitas Ranking of National Higher Education Systems (U21) devised by Universitas 21. Since then, the index attracted attention and positive and negative critique on its methodology. According to Soh (2014), although it has a clear theoretical base and more trustworthy data sources compared to other ranking methodologies, its weights show discrepancy as they are subjectively assigned. Also, Millot (2014) concludes that U21 has the potential to differentiate itself from university rankings and become a valuable supplement in assessing higher education.

The aim of this paper is to analyze the subjective weighting scheme of the U21 ranking and to propose a new one that will rely on a statistically defined framework. The multivariate statistical analysis used to perform such a task is the Composite I-distance Indicator (CIDI) methodology (Dobrota et al., 2016).

The paper is organized as follows: the second section features the U21 ranking methodology, followed by the statistical method used to perform the analysis: the CIDI methodology. The research results are presented and elaborated in Section 4, while we provide the concluding remarks in the final chapter.

2. UNIVERSITAS U21 RANKING OF NATIONAL HIGHER EDUCATION SYSTEMS

Universitas 21, an international group of 25 world universities, devised in 2012 a composite index for ranking national higher education systems and named it U21. The basic idea of the Universitas 21 group was to draw attention from the ranking of universities and individual institutions on the ranking of the national higher education systems. To achieve its goal, the U21 composite index includes four categories (*Resources, Environment, Connectivity,* and *Output*) and 25 indicators. The index is calculated for 50 world countries, but due to the lack of data, the recreated database, which we used to perform the analysis, contains data for 48 countries; Brazil and Saudi Arabia had to be excluded from further research.

The data for 25 indicators, which are used for the computation of the ranking according to the latest methodology, is collected from reputable sources such as OECD, UNESCO, and the World Economic Forum (WEF) (Universitas 21, 2015). Table 1 provides the categories, indicators, effective weights, and codes of indicators, assigned by the authors for easier presentation in the rest of the manuscript.

The *Resources* category provides information on the material and immaterial pre-conditions for the core transformation processes in a higher education system. This dimension aims at measuring the government's readiness to invest in higher education and at investigating what are the consequences of their investment. Although resources are vital for a system to operate, they are not enough to ensure its efficient and proper functioning (Williams et al., 2013). To ensure the effective use of inputs, a regulatory *Environment* is needed. Lately, the idea of internalization became firmly embedded in the institutional mission statements, strategies, as well as national policy frameworks. Category *Connectivity* aims at measuring the relationship between the national higher education system and the industry and government. Finally, the last category (*Output*) includes the measurement of higher education systems output through the scientific output (research papers), the number of scientific workers, enrolment rate in higher education institutions, as well as the percentage of the population that has a college degree.

Although being a comprehensive ranking methodology obtained using mostly objective data, U21 ranking has its limitations. Namely, U21 methodology has been criticized for several reasons (Rauhvargers, 2014). One of the drawbacks is that the model is, in fact, a production model (Cheng, 2012). Another is that the index does not include measurements of teaching while it gives high significance to output (Millot, 2014). For this research, the most important critiques are the ones regarding the weighting scheme and the aggregation method. As many composite indexes, U21 faces the issue of expert-driven weights. The lack of information and justification of the assigned weights are one of the major drawbacks of this newcomer to the university ranking scene (Soh, 2014).

The aim of this research is the alteration of the U21 weighting scheme, thus making it data-driven. We propose the twofold Composite I-distance Indicator (CIDI) methodology to obtain objective and unbiased weights.

3. METHODOLOGY

3.1 Composite I-distance Indicator (CIDI) Methodology

A need for an unbiased ranking of countries was emphasized in the 1960s. Many ranking methodologies emerged, but one that stood out was the I-distance method devised by Ivanovic (1977). Namely, his method ranked countries according to their level of socio-economic development by using several indicators. What sets the I-distance apart from the others is its ability to bypass the process of weighting individual indicators as it aggregates indicators without assigning weights. Also, recent research shows that the I-distance can be applied with success not only in various fields but for both creation (Zornic et al., 2015) and evaluation of composite indexes (Dobrota et al., 2015).

Table 1 U21 categories, indicators, devised indicator codes, and their effective weights (Universitas 21, 2015)

Category	Indicator	Code	Effective weight
Resources (20%)	Government expenditure on tertiary education as a % of GDP, 2011	R1	5.0%
	Total expenditure on tertiary education as a % of GDP, 2011	R2	5.0%
	Annual expenditure per student (full-time equivalent) by tertiary education institutions at USD purchasing power prices, 2011	R3	5.0%
	Expenditure in tertiary institutions for research and development as a percent of GDP, 2012	R4	2.5%
	Expenditure in tertiary institutions for research and development per head of population at USD purchasing power prices, 2012	R5	2.5%
Environment (20%)	Proportion of female students in tertiary education, 2012	E1	1.0%
	Proportion of academic staff in tertiary institutions who are female, 2012	E2	2.0%
	Data quality	E3	2.0%
	Qualitative measure of the policy environment	E4	10%
	Responses to WEF survey question: “How well does the educational system in your country meet the needs of a competitive economy?”	E5	5.0%
Connectivity (20%)	Proportion of international students in tertiary education, 2012	C1	4.0%
	Proportion of articles with international collaborators	C2	4.0%
	Number of open access full text files on the Web, per head of population, 2009-2013	C3	2.0%
	External links that university web domains receive from third parties, per head of population, 2009-2013	C4	2.0%
	Rating of knowledge transfer between university and companies, 2013	C5	4.0%
	Percentage of university research publications co-authored with industry researchers, 2009-2012	C6	4.0%
Output (40%)	Total number of journal articles produced by higher education institutions, 2012	O1	10.0%
	Total articles produced by higher education institutions per head of population, 2012	O2	3.0%
	Average impact of articles measured by citations in 2012 to articles published in previous years using Karolinska Institute normalized impact factor	O3	5.0%
	Weighted Shanghai ranking scores for universities per head of population, 2014	O4	3.0%
	Average of nation’s best three universities on the 2014 Shanghai Jiao Tong ranking	O5	7.0%
	Tertiary enrolment rates as a percentage of the eligible population, 2012	O6	3.0%
	Percentage of population aged 24-64 with a tertiary qualification, 2012	O7	3.0%
	Number of researchers in the nation per head of population, 2012	O8	3.0%
	Unemployment rate of the tertiary educated compared with unemployment rates of those with only upper or post-secondary non-tertiary education, 2012	O9	3.0%

The I-distance method is based on calculating mutual distances between the entities being processed, whereupon they are compared to one another so as to create a rank (Ivanovic, 1977). In order to rank entities (in this case countries) by using the I-distance method, it is necessary to determine one entity as a referent in the observed set. The referent entity can be the minimal, maximal, or average observed or fictive value (Jeremic et al., 2011). In our analysis, the referent entity was the one with minimal values.

For a selected set of variables $X^T = (X_1, X_2, ...X_k)$ chosen to characterize the entities, the I-distance between the two entities $e_r = (x_{1r}, x_{2r}, ...x_{kr})$ and $e_s = (x_{1s}, x_{2s}, ...x_{ks})$ is defined as:

$$D^2(r,s) = \sum_{i=1}^{k} \frac{d_i^2(r,s)}{\sigma_i^2} \prod_{j=1}^{i-1} \left(1 - r_{ji.12...j-1}^2\right) \quad (1)$$

where $d_i(r,s)$ is the distance between the values of the variable X_i for e_r and e_s e.g. the discriminate effect

$$d_i(r,s) = x_{ir} - x_{is} \quad i \in \{1,...k\} \quad (2)$$

σ_i is the standard deviation of X_i, and $r_{ji.12...j-1}$ is the partial coefficient of the correlation between X_i and X_j $(j < i)$ (Ivanovic, 1977).

The construction of the I-distance is an iterative process, which consists of several steps. First, the value of the discriminate effect of the first variable (the most significant variable, which encompasses the highest amount of information on the phenomena upon which the entities will be ranked) is calculated. Then, the value of the discriminate effect of the second variable that is not covered by the first one is calculated. This procedure is repeated for all of the observed variables in the data set (Jeremic & Jovanovic-Milenkovic, 2014).

The values obtained using the I-distance value are not comparable as they represent the distance between entities. Therefore, I-distance results could be employed so as to create a weighting scheme (Dobrota et al., 2016). Namely, besides aggregating variables, I-distance method can determine the relevance of the input criteria and so clearly point out variables which are important for their contribution to the final rank (Jeremic et al., 2011). Namely, Pearson's correlation coefficient between each indicator and the I-distance value provides additional information about the importance of each indicator for the ranking process. Therefore, weights can be determined as the ratio of the indicator's correlation coefficient and the sum of all correlation coefficients with I-distance value. The proposed methodology is called the Composite I-distance Indicator (CIDI) methodology. The equation for determining weights is:

$$w_i = r_i \Big/ \sum_{j=1}^{k} r_j \quad (3)$$

where $r_i (i = 1,...,k)$ is the Pearson's correlation coefficient of variables with the I-distance value (Dobrota et al., 2016; 2015). The sum of the obtained weights equals 1 at both indicator and domain level. Therefore, applying the newly obtained weights on the original data provides unbiased and comparable results and rankings.

3.2 Twofold CIDI Approach

The twofold approach for evaluation has repeatedly been used in operational research and statistics (for example Simar & Wilson, 2007). However, the twofold I-distance approach has been recently introduced by Maricic and Kostic-Stankovic (2016) and Jovanovic-Milenkovic et al. (2015). The basic idea of the fresh approach was to follow the structure of the composite index and apply the I-distance method on each of the indicator levels. Therefore, the I-distance method is applied several times before obtaining the overall result. Herein we propose a twofold CIDI approach based on the idea of the twofold I-distance approach.

The original twofold I-distance algorithm has been changed, and the latest development of the CIDI methodology has been incorporated into it. The first step remains the same; the I-distance is applied on indicators within each category to obtain the Category I-distance value. Next, correlation coefficients between each indicator and the Category I-distance value it belongs to are calculated to perform the CIDI in the following step. Upon acquiring the CIDI indicator weights, the new CIDI Categories are calculated. Again, the procedure is repeated to obtain the CIDI category weights. Therefore, the weighting scheme is now acquired on two separate levels: first on the indicator level and second on the category level.

4. RESULTS AND FINDINGS

The aim of this paper was to scrutinize the U21 weighting scheme using the twofold CIDI methodology which is based on the previously introduced I-distance method. First, the CIDI methodology was employed on indicators of each category and afterwards on the newly calculated CIDI category values. The obtained CIDI weights and the effective weights are presented in Table 2.

Table 2 Weights of U21 indicators and categories based on the CIDI methodology

Category	Indicator	Weight assigned to indicators within category (a)	Weight assigned to category (b)	Effective weights (a*b)
Resources	R1	20.2%	24.22%	4.89%
	R2	17.9%		4.33%
	R3	20.4%		4.94%
	R4	19.8%		4.79%
	R5	21.7%		5.25%
Environment	E1	21.90%	23.83%	5.21%
	E2	18.70%		4.45%
	E3	17.90%		4.26%
	E4	24.90%		5.93%
	E5	16.60%		3.95%
Connectivity	C1	15.10%	27.31%	4.12%
	C2	15.80%		4.31%
	C3	15.00%		4.10%
	C4	18.40%		5.02%
	C5	19.30%		5.27%
	C6	16.40%		4.48%
Output	O1	7.1%	24.64%	1.75%
	O2	12.1%		2.99%
	O3	13.8%		3.41%
	O4	12.4%		3.06%
	O5	13.6%		3.36%
	O6	9.8%		2.42%
	O7	11.8%		2.91%
	O8	11.9%		2.94%
	O9	7.5%		1.85%

When analysing the new weighting scheme on the category level, we can see that CIDI suggests balanced weights. Such a distribution of weights is in accordance with the attitude held by Hazelkorn (2014), who argues that the balance is needed for the optimal functioning of the higher education system. The biggest difference in the weights assigned to categories is in the case of *Output*, which has been reduced from 40% to 24.64%. It is crucial that any ranking methodology, either ranking of higher education systems, either higher educational institutions, does not give significantly more importance to a particular aspect of education. Putting ahead high-quality outputs at the expense of lecture and teaching quality can lead to a situation in which the quality of the basic university mission significantly drops.

To better present the differences between the newly obtained and the official weighting scheme, the comparison of the official U21 and CIDI effective weights is provided. Namely, within the category *Resources*, the biggest weight changes occurred for indicators R4 and R5. According to the official

methodology, both indicators have effective weights of 2.5%, and now their effective weight increased to 4.79% (R4) and 5.25% (R5). These two indicators measure the level of expenditure on research and development, and an increase in their significance is in accordance with the idea of improving the competitiveness of the higher education system. In the next category, *Environment*, CIDI suggests more evenly distributed weights. Namely, according to the official methodology, the effective weights vary from 1 to 10%, and according to the CIDI they vary from 3.95 to 5.93%. Indicators E1 and E2, which measure the share of the female population in higher education (as a student and as a teacher) gained importance. It can be concluded that the new weighting scheme favours gender equality. The significance of the indicator E4 has reduced from 10% to 5.93%. Though this indicator is comprehensive and consists of sub-indicators, it is based on surveys conducted by Universitas. The validity of data collected using the survey is questionable, therefore, lowering the weight assigned to this indicator can be justified as a tendency to reduce the subjectivity of the overall index. All indicators of the category *Connection* gained importance, whereas indicators C3 and C4 stand out as their effective weights increased by 2.1 and 3.02 percentage points respectively. These indicators measure the presence of higher education institutions on the Internet and number of open access articles. Both indicators are oriented to measure the implementation of modern technologies in higher education, so the rise of their importance is in accordance with global trends. Weights of the fourth category, *Output*, went through drastic changes; their values either decreased or remained almost unchanged. For example, indicator O1, which measures the total number of published scientific papers, plummeted from 10% to 1.75%. Giving high significance to just one aspect of the output of higher education limits the overall metric, so the proposed weight reduction is justified. Also, we should mention the reduction of significance indicator O5, which is defined as the average value of the top three universities in the Shanghai ranking. As several authors raised the question of the validity of the Shanghai ranking list (for example Docampo & Cram, 2015; Dobrota & Dobrota, 2016), reducing the impact of its results should not be interpreted as a pitfall of the CIDI weighting scheme.

When the new weighting scheme was obtained, it was possible to calculate the values of the CIDI index using the official data and the CIDI weights. In Table 3 are given CIDI index values, CIDI ranks, and their comparison with the official U21 scores for the top 15 observed countries.

Table 3 Twofold CIDI scores, ranks, and comparison with the official U21 scores and ranks for 2015, 15 top ranked countries according to twofold CIDI values

Country	Twofold CIDI score	Twofold CIDI rank	U21 score	U21 rank
Switzerland	75.95	1	87.1	2
Sweden	74.17	2	84.7	5
Denmark	74.09	3	85.3	3
Finland	73.90	4	85.2	4
United States	73.63	5	100	1
Canada	69.60	6	82.8	6
Netherlands	68.90	7	81.6	7
Singapore	67.70	8	80.3	9
Norway	65.92	9	75.3	12
Austria	65.20	10	74.6	13
Australia	64.86	11	77.1	10
United Kingdom	64.50	12	80.6	8
Belgium	64.44	13	76.0	11
Germany	60.20	14	72.1	14
New Zealand	59.83	15	69.6	16

The ranks of the countries covered in the research largely coincide; however, differences between U21 and CIDI results can be observed. The measured Pearson's correlation coefficient is $r=0.862$ ($p<0.01$), which means that the correlation between the two overall scores is strong. Countries in the CIDI top 15 who dropped the most compared to the official U21 methodology, are the United States and the United Kingdom, both for 4 places. The reasons for such a difference in ranks can be found in the new weighting scheme. Namely, both countries are ranked exceptionally by the *Output* category, which is, according to the proposed methodology, less important for the ranking process. On the other hand, Sweden, Norway, and Austria have advanced for 3 places, as the proposed weighting scheme is more balanced and favors egalitarian societies and systems. Other countries are ranked similarly by both methods, with little rank changes. In order to thoroughly assess the validity of CIDI indicator, in addition to the comparison of the CIDI and U21 scores, we

compared their ranks. The obtained Spearman's correlation coefficient is also very high, and statistically significant, $r_s = 0.867$ ($p<0.01$).

5. CONCLUSION

In the recent years, a new type of rankings appeared: rankings of national higher education systems. Together with global university rankings, they are becoming a valuable tool for framing higher education on a global scale. However, their results should be used with caution due to their possible statistical inaccuracy and their influence to push the academic world into becoming more oriented on its assessment than its primary mission - teaching (Shin, Toutkoushian, & Teichler, 2011). Nevertheless, there are many drivers fueling further development and application of rankings, so it is exceptionally important to provide rankings as accurately as possible.

One of the newcomers to the rankings market is the U21 ranking of national higher education systems. The creators of this ranking acknowledged the priority of devising a tool for comparing national higher education systems across countries. They have taken courageous steps to deal with such a daunting task, but there is still place for improvement (Millot, 2014). Major concerns have arisen regarding its subjective weighting scheme. Therefore, the aim of this paper was to analyze and suggest a novel, data-driven weighting scheme based on the CIDI methodology. Namely, the methodology has previously been applied with success for assessing ranking methodologies of universities (Dobrota et al., 2016).

The twofold CIDI approach was implemented on the U21 index. Research findings show that among the categories, *Connectivity* stands out as the most important for the ranking system, followed by *Output*. This is a change compared to the official weighting scheme, as the focus is moved from *Output* to other categories.

In the case of indicators, the analysis outlined that *Output* category needs refinement as some indicators were given significantly lower importance compared to the official ranking methodology, especially the indicator related to the number of published papers. What can also be noted is that the U21 is missing complex bibliometric indicators such as percentile-based indicators which take into account the citations count (for example Bornmann & Mutz, 2014). Also, differences in citing behavior between sciences should be taken into account. A study conducted by Bornmann, de Moya Anegón, and Mutz (2013) proved that certain subject-specific types of institutions are in advantageous position when it comes to ranking in terms of outcome performance. Therefore, one of our suggestions for further development of the U21 ranking is the inclusion of more sophisticated bibliometric indicators.

Two other directions of further research could be additionally defined. First, the question of the level of objectivity of metric arises. Performing the CIDI methodology (either one-fold or two-fold) creates an objective metric, and eliminates the experts' knowledge. However, such an approach can raise certain concerns regarding the possibility of creating a measurement that may not be in accordance with the nature of the observed phenomenon. Therefore, we suggest a hybrid approach (Maricic et al., 2015). Namely, weights on one indicator level could be redefined using the CIDI methodology, while the weights on the other level would be left as suggested by the experts. Such an approach would take into account benefits of both subjective and data derived weighting methods. Next, the presented results suggest that the number of indicators can be refined. To tackle this, the I-distance post hoc analysis could be employed (Markovic et al., 2016). This analysis is an iterative process where the number of indicators in each iteration is reduced for the indicator which has the lowest correlation coefficient with previously obtained I-distance value.

International academic rankings are faced with methodological difficulties which affect the validity of their results. Herein we proposed a transparent approach for redesigning a ranking methodology that is primarily oriented on the process of assigning weights. We believe our paper might act as an incentive for further academic research on the topic of national higher education systems rankings and their weighting schemes.

REFERENCES

Bornmann, L, de Moya Anegón, F., & Mutz, R. (2013). Do universities or research institutions with a specific subject profile have an advantage or a disadvantage in institutional rankings? *Journal of the Association for Information Science and Technology, 64*(11), 2310-2316. doi: 10.1002/asi.22923

Bornmann, L., & Mutz, R. (2014). From P100 to P100': A new citation-rank approach. *Journal of the Association for Information Science and Technology, 65*(9), 1939-1943. doi: 10.1002/asi.23152

Cheng, S. K. (2012). The U21 rankings of national higher education systems: re-analyze to optimize. *European Journal of Higher Education, 2*(2-3), 205-217. doi: 10.1080/21568235.2012.697695

Dobrota, M., & Dobrota, M. (2016). ARWU ranking uncertainty and sensitivity: What if the award factor was excluded? *Journal of the Association for Information Science and Technology 67*(2), 480-482. doi: 10.1002/asi.23527

Dobrota, M., Bulajic, M., Bornmann, L., & Jeremic, V. (2016). A new approach to the QS university ranking using the composite I-distance indicator: Uncertainty and sensitivity analyses. *Journal of the Association for Information Science and Technology, 67*(1), 200-211. doi: 10.1002/asi.23355

Dobrota, M., Martic, M., Bulajic, M., & Jeremic, V. (2015). Two-phased composite I-distance indicator approach for evaluation of countries' information development. *Telecommunications Policy, 39*(5), 406-420. doi: 10.1016/j.telpol.2015.03.003

Docampo, D., & Cram, L. (2015). On the effects of institutional size in university classifications: the case of the Shanghai ranking. *Scientometrics, 102*(2), 1325-1346. doi: 10.1007/s11192-014-1488-z

Harzing, A. W., & Mijnhardt, W. (2015). Proof over promise: towards a more inclusive ranking of Dutch academics in Economics & Business. *Scientometrics, 102*(1), 727-749. doi: 10.1007/s11192-014-1370-z

Hazelkorn, E. (2014). Reflections on a Decade of Global Rankings: what we've learned and outstanding issues. *European Journal of Education, 49*(1), 12-28. doi: 10.1111/ejed.12059

Huang, M. H. (2012). Opening the black box of QS World University Rankings. *Research Evaluation, 21*(1), 71-78. doi: 10.1093/reseval/rvr003

Ivanovic, B. (1977). Classification Theory. Institute for Industrial Economic, Belgrade.

Jeremic, V., & Jovanovic-Milenkovic, M. (2014). Evaluation of Asian university rankings: Position and perspective of leading Indian higher education institutions. *Current Science, 106*(12), 1647-1653.

Jeremic, V., Bulajic, M., Martic, M., & Radojicic, Z. (2011). A fresh approach to evaluating the academic ranking of world universities. *Scientometrics, 87*(3), 587-596. doi: 10.1007/s11192-011-0361-6.

Marginson, S., & van der Wende, M. C. (2007). Globalization and higher education. Education Working Paper No. 8. Paris: OECD.

Maricic, M., & Kostic-Stankovic, M. (2016). Towards an impartial Responsible Competitiveness Index: a twofold multivariate I-distance approach. *Quality & Quantity, 50*(1), 103-120. doi: 10.1007/s11135-014-0139-z.

Maricic, M., Bulajic, M., Martic, M., & Dobrota, M. (2015). Measuring the ICT Development: The Fusion of Biased and Objective Approach. Proceedings of the XII Balkan Conference on Operational Research (BALCOR 2015), September 9-13, Constanta, Romania.

Marković, M., Zdravković, S., Mitrović, M., & Radojičić, A. (2016). An Iterative Multivariate Post Hoc I-Distance Approach in Evaluating OECD Better Life Index. *Social Indicators Research, 126*(1), 1-19. doi: 10.1007/s11205-015-0879-8.

Martin, M., & Sauvageot, C. (2011). Constructing an indicator system or scorecard for higher education: A practical guide. Paris: International Institute for Educational Planning

Millot, B. (2014). Top Universities or Top Higher Education Systems? *International Higher Education*, (75), 7-8.

Rauhvargers, A. (2014). Where are the global rankings leading us? An analysis of recent methodological changes and new developments. *European Journal of Education, 49*(1), 29-44. doi: 10.1111/ejed.12066

Saisana, M., & D'Hombres, B. (2008). Higher Education Rankings: Robustness Issues and Critical Assessment; How much confidence can we have in Higher Education Rankings? Luxembourg: JRC.

Saisana, M., D'Hombres, B., & Saltelli, A. (2011). Rickety numbers: Volatility of university rankings and policy implications. *Research policy, 40*(1), 165-177. doi: 10.1016/j.respol.2010.09.003.

Shin, J. C., Toutkoushian, R. K., & Teichler, U. (Eds.). (2011). University rankings: Theoretical basis, methodology and impacts on global higher education. Springer Science & Business Media.

Simar, L., & Wilson, P. W. (2007). Estimation and inference in two-stage, semi-parametric models of production processes. *Journal of econometrics, 136*(1), 31-64. doi: 10.1016/j.jeconom.2005.07.009

Soh, K. (2014). Nominal versus attained weights in Universitas 21 Ranking. *Studies in higher education, 39*(6), 944-951. doi: 10.1080/03075079.2012.754866

Universitas 21. (2015). U21 Ranking of National Higher Education Systems 2015. Melbourne Institute of Applied Economic and Social Research, University of Melbourne, Melbourne, Australia

Williams, R., de Rassenfosse, G., Jensen, P., & Marginson, S. (2013). The determinants of quality national higher education systems. *Journal of Higher Education Policy and Management, 35*(6), 599-611. doi: 10.1080/1360080X.2013.854288

Zornic, N., Bornmann, L., Maricic, M., Markovic, A., Martic, M. & Jeremic, V. (2015). Ranking institutions within a university based on their scientific performance: A percentile-based approach. *El Profesional de la informacion, 24*(5), 551-566. doi: 10.3145/epi.2015.sep.05.

SELECTING AN APPROPRIATE METHOD FOR MISSING DATA IMPUTATION: A CASE OF COUNTRIES RANKING

Jovana Rakićević*[1], Gordana Savić[1], Milica Bulajić[1]

[1]University of Belgrade, Faculty of Organizational Sciences
*Corresponding author, e-mail: jovana.rakicevic@fon.bg.ac.rs

Abstract: *One of the general problems we face when crating composite indices is the missing data. It is almost impossible to have complete datasets for all the observed entities according to different indicators. Firstly, the paper discusses what to do when having incomplete datasets. The easiest ways are to exclude the indicators or the cases for which a large amount of data is missing. None of these solutions is the best, since neither we want to lose any aspect of the observed phenomenon, nor the cases we observe. Therefore, we need to opt for an imputation technique. The paper further provides an overview of several ideas and explanations of imputation, and addresses the next problem that arises on how to select one appropriate technique among the available ones. Bearing in mind the extent to which the data can be manipulated when imputing, we provide an analysis oriented to find an answer to the posed question. The analysis tests six single imputation techniques applied to several countries for two observed indicators – R&D expenditures and R&D researchers.*

Keywords*: missing data, imputation, single imputation, mean imputation, regression imputation, cluster analysis, composite index*

1. INTRODUCTION

Composite indices have evolved and become a very popular way of assessing large phenomena that cannot be captured by one single indicator. They serve as a tool for measuring countries performance, and ranking accordingly. Scholars and international organizations create different methodologies for constructing composite indices to meet a wide range of purposes, primarily to "fairly" rank the countries and enable the cross-country comparisons, and to facilitate the strategic decision-making processes. Examples include assessments of human development, ICT development, technological readiness, e-readiness, innovativeness, competitiveness, sustainability, wellbeing, quality of life, gender equity, ease of doing business and many others (see Bandura, 2008).

However, although having dozens of new or improved composite indices every year that are proven to have many positive aspects, we should be aware of their shortages and different difficulties we come across while constructing. There are several general problems we face: from selecting the indicators that will be included in the final index, through finding the right sources for collecting the data, dealing with the missing data and standardizing the data, to finding the right methods for weighting and aggregating the selected indicators. Our decisions in each step will highly affect the final result. For example, Grupp and Mogee (2004) showed how innovation scoreboards can be manipulated in the policymaking system, depending on the selected indicators. Hurdlikova (2013) showed seven different scenarios of the EU countries ranking according to the selected indicators for Europe 2020 with the aim to highlight the sensitivity of results which vary and depend on choosing both the normalization methods and the weighting and aggregation schemes. One of the mostly criticized aspects of constructing indices is the choice of weighting method, since weights are subjective by nature and can considerably affect the final results. Cherchye et al. (2006), and Filippetti and Peyrache (2011) propose the use of Data Envelopment Analysis (DEA) for this purpose. However, there is one crucial problem which precedes, and that is the missing data.

The authors have been creating a composite index of technological capability of countries and experienced how difficult it could be to deal with the missing data problem, since different imputations can highly affect the changes of ranks, i.e. the final scores of countries. As Foa and Turner (2012) highlight, one of the key decisions we have to make when designing composite indices is how to deal with this problem in such a manner to ensure that the final index values reflect a meaningful image of the available information. This paper firstly provides an overview of existing imputation techniques, and then addresses the issue of missing data imputation in such a manner to provide explanations on how to select the most appropriate imputation technique. We restrict the analysis to the single imputation techniques implemented in IBM SPSS Statistics 22. In some cases cold desk imputation is the most appropriate, sometimes the regression analysis provides better results than the simple mean value, in some cases it is better to firstly classify the countries and then to impute the missing values by using an average cluster value or regression analysis over the selected cluster, etc. This will be elaborated later in the text.

The rest of the paper is organized as follows. Section 2 explains the possible ways to solve the problem of missing data and provides an overview of several imputation techniques. Section 3 provides an analysis on choosing the "right" imputation technique among six applied on the sample of several countries observed according to two indicators – R&D expenditures and R&D researchers; root mean square error is calculated in order to test decisions by finding accuracy of the applied techniques on different datasets for two of other indicators used for assessing countries' technological capability: ICT goods imports and Electric power consumption. This section offers the results and discussion of the study. Section 4 concludes the paper.

2. SOLVING THE PROBLEM OF MISSING DATA

After deciding which indicators to include in an index, we collect the data. At this point we become aware of the amount of the missing data, and whether we will be able to encompass the selected group of indicators or not. If a lot of data is missing that cannot be imputed meaningfully, we have to exclude some indicators from the analysis, i.e. to drop out the variables or instances for which the data is missing. So, the **case deletion** is the first and the most radical way of dealing with this problem. This method is used in the case when, for example, among the observed countries we miss the values for the majority of countries for the larger part of the observed period of time, so that we cannot estimate and impute the missing values. For example, the famous Human Development Index deals with the missing data problem in this way, selecting the variables for which complete data across the domain of countries is relatively easy to obtain, restricting to a small set of indicators for which complete data exists. On one hand this is good since it provides objective and more reliable results, but on the other hand this way we cannot include all important aspects of one phenomenon, but have to restrict to the basic ones. The case deletion approach is, of course, appealing because of its simplicity. However, this is not applicable in cases when missing values cover a lot of instances, or their presence in essential attributes is large (Little & Rubin, 1987).

Generally, if this radical exclusion of indicators is not needed or wanted, composite indices can deal with the problem of missing data in three ways (Foa &Tanner, 2012). The first and the simplest solution is to drop out any country for which complete data does not exist; the second solution is to impute missing values using different methods; and the third is to use only existing data in the estimation of the index, but supplementing with an estimated margin of error. The first solution of reducing the sample is not always acceptable, especially if we want to make the global cross-country comparisons. However, there are indices, as the Doing Business Indicators whose authors want to avoid the methodological problems and obtain an objective result (Foa & Turner, 2012). This is why the country domain is smaller than in the case of e.g. ArCo index of technological capability of countries (Archibugi & Coco, 2004), which is measured for 162 countries. So, in order to enlarge the sample, we need to find the "right way" of imputing the missing values, always having in mind that the selection of methods manipulates the results. We will discuss this in detail in the Section 2.1. The third proposed solution refers to using only the existing data in the estimation of the index, but supplementing the results with an estimated margin of error, based on the number of missing items, among other criteria observed. This approach is used in a number of recent indices such as the Corruptions Perceptions Index (CPI) where the confidence range indicates the reliability of the country scores. It tells that allowing for a margin of error we can be 90 percent sure that the true score for countries lies within the given range.

2.1. Missing data imputation techniques – an overview

The literature on the analysis of missing data is extensive and in rapid development. OECD & EC-JRC (2008) published the *Handbook on Constructing Composite Indicators – Methodology and User Guide*, which provides help in creating indices. The Handbook aims to contribute to a better understanding of the complexity of composite indicators and to an improvement in the techniques currently used to build them. Among others, the Handbook deals with the problem of missing data imputation, and suggests single and multiple imputations as possible solutions. As defined in the Handbook, "imputations are means or draws from a predictive distribution of missing values." The predictive distribution must be generated by using the observed data.

Single imputation refers to both implicit and explicit modelling. The implicit techniques are simple. ***Hot desk imputation*** refers to filling in the blanks cells with individual data which are drawn from the unit that has similar characteristics (for example if we observe units according to four indicators and miss a value for one unit for indicator x, we will fill in that missing value with the value of indicator x for the unit which is the most similar to the one observed according to the other three indicators). ***Substitution*** means the replacement of non-responding units with the unselected units in the sample, while ***Cold desk imputation*** is the replacement of missing values with the values from an external source (for example from the previous

realization of the same survey or the value of an indicator from the previous year in the case of assessing the countries performance). Additionally, we propose the ***Simple mean imputation*** which refers to imputing the missing values considering only one instance and its' dataset (separate from the sample), imputing the missing value by finding average of the previous and the next value to the one missing (it is important to have in mind that assessing countries performance we deal with time-series datasets).

Explicit modelling is more complex and demands more detailed explanations. Using ***unconditional mean imputation*** means that we impute the missing values with the sample mean (median, mode) for the observed indicator. The limitation of mean value based imputation and its variations is its focus on a specific variable without taking into account the overall similarities between instances (Ayuyev et al., 2009). This is the easiest way of explicit modelling, but not always precise enough. Therefore, we could use other two more sophisticated techniques. Firstly, the ***regression imputation*** where missing values are imputed with the predicted values obtained by regression. Here we observe dependent variable and independent variable(s). The dependent variable is the indicator for which we miss some values, and the independent variable(s) is (are) the individual indicator(s) which show strong relationship (usually high correlation) with the dependent variable. ***Expectation maximization imputation*** focuses on the interdependence between parameters of the model and the missing values. It is an iterative process. First, the missing values are predicted based on initial estimates of the model parameters values. These predictions are then used to update the parameters values, and the process is repeated. The sequence of parameters converges to maximum-likelihood estimates, and the time to convergence depends on the proportion of missing data and the flatness of the likelihood function. For more detailed mathematical explanation on explicit modelling techniques see OECD & EC-JRC (2008, pp. 55-58).

Multiple imputation is considered to be one of the most powerful approaches to missing values estimation (Ayeyev et al., 2009). It is a general approach that does not require a specification of parameterised likelihood for all data. The missing data is imputed with a random process that reflects uncertainty. Imputation is done N times, to create N "complete" datasets. The parameters of interest are estimated on each data set, together with their standard errors. Average (mean or median) estimates are combined using the N sets and between-and within-imputation variance is calculated. Although any imputation method can be used in multiple imputation (used repeatedly to obtain N values), one of the most general models is the ***Markov Chain Monte Carlo (MCMC) method***. It is a sequence of random variables where the distribution of the observed element depends on the value of the previous one. It is assumed that data are drawn from a multivariate normal distribution and requires the following assumptions: missing at random (MAR) and missing completely at random (MCAR). For more detailed explanation see OECD & EC-JRC (2008, pp. 58-61). For example, the Environmental Sustainability Index uses the MCMC technique to substitute the missing values (Srebotnjak, 2001).

Based on the amount of operations performed, Zhang (2011) presents the following categorisation of imputation techniques: single, multiple, fractional and iterative. **Fractional imputation** represents a compromise between the single and multiple imputation methods, while **iterative imputation** techniques primarily use a generate-and-test mechanism, taking into account useful information (including incomplete cases).

Fujikawa and Ho (2002) consider a **clustering based approach for missing data imputation**, where the premise is that units could be grouped such that all the imputations in identified groups are independent from other groups. ***Distance-based clustering*** is focused mainly on development of supervised clustering methods and mean/mode based imputations in these clusters (De Mántaras, 1991). They are based on a strict separation for objects within clusters, so it is assumed that there is no influence of instances in one cluster to an imputation process in other clusters. Ayuyev et al. (2009) suggest the improved ***dynamic clustering-based imputation (DCI)*** of missing values in mixed type data. They consider the appropriate choice of a method for imputation especially important when the fraction of missing values is large and the data are of mixed type. The proposed DCI algorithm relies on similarity information from shared neighbours, where mixed type variables are considered together. Around each instance with a missing value they deterministically construct an independent cluster of similar instances with no missing values for a particular attribute. In contrast to a typical clustering method, they allow cluster intersections meaning that the same unit may be included in many clusters. It relies on a distance measure that considers both categorical and continuous variables and is applicable for estimation of missing values in high dimensional mixed type data.

Different authors propose and analyze other complex algorithms for missing data imputation. For example, Abdella & Marwala (2005) introduced a new method for imputing the missing values which uses a combination of **genetic algorithms and neural networks** for approximation of the missing data. Nelwamondo et al. (2007) compare neural network and expectation maximization techniques, while Lobato

et al. (2015) offer a **multi-objective genetic algorithm** for missing data imputation (MOGAImp) which is an iterative imputation technique. Explanation of these complex methods is beyond the scope of this paper.

3. MISSING DATA IMPUTATION: MAKING A CHOICE AMONG SIX SINGLE IMPUTATION TECHNIQUES – RESULTS AND DISCUSSION

While assessing the technological capabilities of countries, we faced the missing data problem. Firstly, we needed to exclude some of the indicators because of a large amount of data missing for the observed period of time. Secondly, we excluded some countries with incomplete datasets, where meaningful imputations could not be performed. Among the countries left, we needed to impute the missing values for some crucial indicators that could not be excluded from the analysis, such as *Researchers in R&D (per million people) – IND1* and *R&D expenditures (% of GDP) – IND2*. In this section we will try to elaborate and explain how to choose the "right" imputation technique on the example of these two indicators, selecting from the six single imputation techniques applied. Table 1 shows the results of imputation using the following techniques: CD – Cold desk imputation, SM – Simple mean imputation, EM – Expectation maximisation imputation, R – Regression imputation, C-M – Cluster mean imputation, C-R – cluster regression imputation. For two countries we apply C-R_{II}, which will be explained later in the text. For the first and the second indicator we analyse four and five countries, respectively. For each country, in the first row we present the existing dataset for the observed period. Framed positions are missing. In the next six (or seven) rows we present different results obtained by applying the mentioned techniques. We marked the chosen (most appropriate) techniques by putting an asterisk next to the technique(s) name(s) and formatting numbers in bold.

As we can see from the Table, CD imputation can be used always. We propose it to be applied this way: if the value for one year exists and we miss the value for the previous one, we impute the missing value by copying the value from the current year (e.g. Chile for both indicators). Otherwise, if we have the previous values, we always consider that to be a better situation, and copy that value for the next year missing (e.g. Greece for IND1). This technique is surely not accurate enough, but sometimes better to be applied that the others. This refers mainly to the cases where we miss the values for long time period. It is hard to predict the trend of the indicator in the past/future, especially if we miss the values for the same period for the indicator that is correlated with the one observed. This is the case with Chile, where we miss the values for the period 2000-2006 for both indicators and cannot apply the trend from one indicator to the other. For example, for Israel we also miss the values for the long time period 2000-2010, but we are in better situation because we have the whole dataset for Israel for IND2. In this case we firstly clustered the observed countries according to R&D researchers for the periods for which the values exist (2011-2013) and obtained Israel to be in a cluster with Japan, Korea, Sweden and Finland. Then we applied C-R_{II} imputation, meaning that regression analysis is performed over the obtained cluster, using R&D researchers as a dependent variable, and R&D expenditures as the independent. Of course, it is questionable whether we can accept any of these results, since a lot of values are missing. If not, the safest approach is to exclude these two countries from the further analysis. If we accept these values, than we need to be cautious when processing this data because illogical result may appear. In other cases (except Israel, Australia and Greece for IND1) C-R imputation means that we firstly performed the cluster analysis, and then the regression over the observed cluster, for one indicator observed (we did not connect two indicators because the data was missing for both).

Regarding the SM imputation, it is best to be applied in the situation when we miss one value between two which exist, and regression is not applicable because of the unstable trend which cannot be captured. This is the case with Australia and New Zealand for IND2, and for Australia (2005, 2007) and Greece (2000, 2002, 2004) for IND1. The rest of the missing values for both Australia and Greece for IND1 cannot be obtained by SM imputation. We tried to perform C-R_{II} which did not provide satisfactory results, so we use CD for Australia for 2009-2013 (copying value from 2008) and for Greece for 2008-2010 (copying from 2007).

Regression imputation, which refers to performing the regression analysis over the whole sample, is applicable and good when the trend is captured. This is the case with Greece and Luxembourg for IND2. Besides this, both SM and CD could have been applied. This is where we easily see how our decision in this step would affect the final result (score of country). It is interesting to notice that when comparing R and C-R imputation, we obtain quite different results (see e.g. Greece for IND2, period 2008-2010). However, none of these gives good results if a lot of data is missing, and the trend cannot be captured.

C-M imputation has not proved to be a good solution in any of the cases presented. Large deviations from the existing values are noticed. For example, for Chile for IND1 we obtained the following values for the missing period 2000-2006: 543.62, 539.82, 569.74, 592.36, 640.42, 700.28, 683.89, and the existing value for 2007 is 337.18. It doesn't reach even 400 until the end of the period observed. The problem with C-M is that the instances in one cluster should be really close in order to be in a position to perform this imputation

technique. That cannot be the case with Chile which is among the countries with the lowest values in the sample. In this case average of both the cluster and the sample would be over the values for Chile. This is also the case if we observe the country among those with the highest values in the sample (the mean value, both cluster and sample, will always be lower than needed).

Table 1: Comparison of the applied techniques – results for R&D researchers and R&D expenditures

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
INDICATOR 1: R&D researchers per million people *(World Bank)*														
Australia	3454.26	3549.72	3749.7	3664.8	4062.53		4231.78		4335.39					
CD*						4062.53		4231.78		**4335.39**	**4335.39**	**4335.39**	**4335.39**	**4335.39**
SM*						**4147.15**		**4283.59**		N.A.	N.A.	N.A.	N.A.	N.A.
EM						3741.31		4305.16		3709.33	4063.27	3789.79	4182.98	3855.18
R						3843.00		4125.18		4350.37	4357.64	4108.17	3886.09	3831.81
C-M						3061.57		3753.61		3875.63	4005.01	4121.30	4261.08	4291.60
C-R						3840.89		4188.89		4098.72	4203.41	4139.55	3770.85	3900.52
C-R_{II}						4147.15		4283.59		3806.46	3802.31	3729.17	N.A.	N.A.
Chile								337.18	357.99	288.71	319.72	353.37	390.95	389.41
CD*	**337.18**	**337.18**	**337.18**	**337.18**	**337.18**	**337.18**	**337.18**							
SM	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.							
EM	349.85	359.16	372.02	318.46	341.41	296.53	376.64							
R	306.51	326.91	308.26	325.33	327.14	327.79	360.91							
C-M	543.62	539.82	569.74	592.36	640.42	700.28	683.89							
C-R	314.71	346.82	338.05	334.93	279.91	283.18	336.52							
Greece		1307.94		1417.21		1769.95	1793.7	1887.83				2212.33	2232.29	2628.16
CD*	1307.94		1307.94		1417.21				**1887.83**	**1887.83**	**1887.83**			
SM*	**1253.31**		**1362.58**		**1593.58**				N.A.	N.A.	N.A.			
EM	1348.65		1293.19		1480.10				2070.03	2096.98	1833.73			
R	1504.79		1524.36		1674.95				2009.35	2164.72	2539.52			
C-M	1333.15		1394.17		1430.71				1686.58	1765.66	1846.37			
C-R	1307.94		1769.95		1887.83				1417.21	1769.95	1307.94			
C-R_{II}	1253.31		1362.58		1593.58				1558.75	1553.60	1549.57			
Israel												7296.25	8282.31	7934.86
CD	7296.25	7296.25	7296.25	7296.25	7296.25	7296.25	7296.25	7296.25	7296.25	7296.25	7296.25			
SM	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.			
EM	7603.40	7514.73	8260.92	8207.10	8323.30	8233.91	7119.58	7363.84	8068.52	8202.68	8379.79			
R	7168.00	7777.79	7664.46	7120.56	7064.76	7459.99	7702.47	8375.10	8159.20	7615.86	7157.08			
C-M	6731.79	7109.84	7427.94	8002.61	7841.8	7544.65	7673.06	7373.24	7692.44	7648.88	7717.48			
C-R	7679.28	7667.56	7257.47	8551.63	7401.66	7614.01	6944.95	7075.53	8344.48	8205.42	8129.85			
C-R_{II}*	**7168**	**7777.79**	**7664.46**	**7120.56**	**7064.76**	**7459.99**	**7702.47**	**8375.1**	**8159.2**	**7615.86**	**7157.09**			
INDICATOR 2: R&D expenditures - % of GDP *(World Bank)*														
Australia	1.576		1.753		1.853		2.182		2.401		2.386	2.249		
CD		1.576		1.753		1.853		2.182		2.401				
SM*		**1.665**		**1.803**		**2.018**		**2.288**		**2.394**				
EM		2.144		2.091		2.122		2.345		1.881				
R		1.608		1.839		2.08		2.146		2.363				
C-M		1.848		1.795		1.789		1.812		1.904				
C-R		2.023		2.066		2.178		2.529		2.014				
Chile								0.311	0.375	0.353	0.331	0.353		
CD*	**0.311**	**0.311**	**0.311**	**0.311**	**0.311**	**0.311**	**0.311**							
SM	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.							
EM	0.361	0.338	0.354	0.346	0.356	0.338	0.341							
R	0.333	0.337	0.323	0.339	0.321	0.307	0.313							
C-M	0.517	0.520	0.504	0.508	0.502	0.519	0.526							
C-R	0.337	0.336	0.316	0.380	0.323	0.334	0.301							
Greece		0.560		0.548	0.529	0.579	0.561	0.576	0.662	0.626	0.598	0.67		
CD	0.560		0.560											
SM	N.A.		0.554											
EM	0.591		0.592											
R*	**0.593**		**0.553**											
C-M	0.517		0.504											
C-R	0.559		0.512											
Luxembourg	1.574			1.652	1.625	1.585	1.692	1.645	1.649	1.719	1.503	1.411		
CD		1.574	1.574											
SM		1.599	1.626											
EM		1.606	1.6											
R*		**1.615**	**1.633**											
C-M		1.902	1.892											
C-R		1.570	1.715											
New Zealand		1.1		1.147		1.117		1.161		1.262		1.248		
CD	1.1		1.1		1.147		1.117		1.161		1.262			
SM*	**1.077**		**1.124**		**1.132**		**1.139**		**1.211**		**1.255**			
EM	1.197		1.188		1.198		1.171		1.168		1.127			
R	1.110		1.103		1.125		1.171		1.174		1.231			
C-M	0.907		0.994		1.027		1.135		1.257		1.406			
C-R	1.113		1.108		1.129		1.177		1.183		1.228			

Performing this analysis, we can easily see how the final country score would surely depend on the imputation technique we decide to apply. Looking for example at Australia for 2005 (IND1), we obtained six pretty different values: 4062.53, 4147.15, 3741.31, 3843.00, 3061.57, and 3840.89 using six techniques. Deciding which to use is completely subjective and enables the manipulation of results. This is a huge problem, since a country could be many places up or down on the list depending on the technique accepted. Besides this, it should be highlighted that one imputation technique cannot be applied for one indicator for all the countries for which data is missing. It highly depends on the nature of the existing data, and the amount of data missing. Additionally, we could conclude that when imputing we should always look at the bigger picture, connecting (when possible) different observed indicators (in our case the correlated R&D expenditures and researchers), in order to ensure the reliability of the imputations.

For the purpose of testing accuracy of imputation methods, we performed another analysis that includes more datasets for two other indicators used for assessing countries' technological capabilities, for which complete data exists across the observed domain of countries: *ICT goods imports (% of total goods imports) – IND3* and *Electric power consumption (kWh per capita) – IND4*. The idea of this analysis is to delete the values for the same years that were missing for IND1 (in Table 1), and calculate the root mean square error (RMSE) for each technique applied, for each country. The results for IND3 are presented in the Table 2. For each country, in the first row we present the existing (complete) dataset for the observed period. In the second row we deleted the values; framed positions are now "missing". Next six rows present different results obtained by applying the same techniques used in the previous analysis. For each technique we calculated the RMSE (presented in the last column) by applying the following formula (Chai & Draxler, 2014):

$$RMSE = \sqrt{\frac{1}{n}\sum_{t=1}^{n}(y_t - \hat{y}_t)^2} \quad (1)$$

where y_t is the observed, actual value and $\hat{y}_t$ is the predicted, imputed value.

The aim of this analysis is to examine whether we would intuitively choose the technique with the smallest error as the most appropriate, following the principle we used for the first analysis. For each country, the techniques with the smallest RMSE are marked by putting an asterisk next to the technique(s) name(s).

Table 2: Testing the accuracy of the applied techniques – Calculating the root mean square error (RMSE)

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	RMSE
INDICATOR 3: ICT goods imports - % of total goods imports *(World Bank)*															
Australia	15.53	13.49	12.38	12.12	12.77	11.76	11.66	10.70	9.13	10.51	10.64	9.83	8.89	8.86	
Deleted values	15.53	13.49	12.38	12.12	12.77		11.66		9.13						
CD						12.77		11.66		9.13	9.13	9.13	9.13	9.13	0.982
SM*						12.22		10.40		N.A.	N.A.	N.A.	N.A.	N.A.	**0.388**
EM*						12.21		9.94		9.79	10.33	8.98	8.42	8.51	**0.593**
R						12.59		11.66		12.28	12.91	10.30	9.89	10.39	1.387
C-M						10.36		8.79		8.68	9.33	8.73	8.27	8.16	1.350
C-R						12.34		11.24		11.14	12.00	10.96	10.08	10.63	1.115
Chile	10.19	9.10	8.57	8.07	8.73	8.24	8.84	7.50	6.18	7.35	7.86	7.08	7.20	7.64	
Deleted values								7.50	6.18	7.35	7.86	7.08	7.20	7.64	.
CD	7.50	7.50	7.50	7.50	7.50	7.50	7.50								1.470
SM	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.								N.A.
EM*	10.07	8.97	7.58	8.33	8.47	8.90	8.01								**0.570**
R	7.27	7.33	7.62	7.14	7.13	7.26	7.53								1.633
C-M	11.41	10.64	9.26	9.16	9.62	10.00	9.57								1.192
C-R	8.11	6.88	7.11	6.64	6.78	6.55	7.87								1.733
Greece	7.43	6.70	5.81	5.84	6.20	5.74	5.67	5.85	5.17	5.45	4.98	4.99	5.10	3.95	
Deleted values		6.70		5.84		5.74	5.67	5.85				4.99	5.10	3.95	
CD	6.70		6.70		5.84				5.85	5.85	5.85				0.687
SM*	6.91		6.27		5.79				N.A.	N.A.	N.A.				**0.329**
EM	5.42		6.80		5.33				4.95	5.45	5.37				0.998
R*	6.70		6.16		5.71				5.37	5.16	4.70				**0.428**
C-M	10.00		8.35		8.32				6.84	7.36	7.61				2.270
C-R	6.49		6.20		5.98				6.88	5.85	5.22				0.839
Israel	14.13	11.48	9.85	9.25	10.40	9.75	9.57	8.48	7.85	9.72	9.20	8.73	8.86	8.76	
Deleted values												8.73	8.86	8.76	
CD	8.73	8.73	8.73	8.73	8.73	8.73	8.73	8.73	8.73	8.73	8.73				2.019
SM	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.				N.A.
EM	11.92	11.97	11.38	10.88	11.00	11.32	11.27	10.71	9.68	10.27	10.11				1.516
R	8.73	8.86	8.90	8.76	8.76	8.75	8.79	8.81	8.75	8.79	8.63				1.990
C-M*	13.49	12.66	11.34	10.43	10.85	11.05	10.91	9.31	8.67	8.58	8.81				**1.041**
C-R	8.71	8.76	8.83	8.79	8.80	8.82	8.74	8.67	8.86	8.82	8.74				2.005

Regarding the values for Australia for IND3 (Table 2), we would certainly choose SM imputation for years 2005 and 2007 (which also has the lowest RMSE), but would definitely make a mistake by choosing CD imputation (RMSE=0.982) for the years 2009-2013, since EM has lower RMSE value (0.593). But not having

the values with which to connect and compare, it would be brave and uncertain to choose EM values as the most appropriate. Here we can easily see how the results are questionable when the data is imputed. Secondly, regarding Chile, the only method we could use is CD since a large amount of data is missing and we cannot predict the trend by connecting to another correlated value (performing C-R_{II}). CD imputation has RMSE value of 1.47, which is much higher than the EM which again proves to be better, with RMSE of 0.57. However, again it would be hard to justify such a decision on choosing EM for imputation. Regarding Greece, we would again be fine with the values for 2000, 2002 and 2004, performing the SM imputation (RMSE=0.329). This shows that it is not a problem when one value is missing between two which exist. However, for the years 2008-2010, a mistake would be made by using CD (RMSE=0.687) instead of R (RMSE=0.428). But it is encouraging that in this case the mistake wouldn't be large, since the values of RMSE are close (unlike for Australia). Israel is the most challenging case, since a large amount of data is missing. As we can see from the RMSE values for all techniques for Israel, the errors are higher. This indicates that inaccurate decision would surely be made when a lot of data is missing. This result is logical and expected, and supports the claim that entities with a large number of missing data should be excluded from the analysis. For the opposite reason SM is always the best technique (but can be applied only in a few cases). For Israel, C-M imputation stands as the best one but still with a large error of 1.041.

In order to obtain a general value of accuracy of the applied techniques, total RMSE is calculated using the aforementioned formula, but gathering the data for all countries. The results are presented for IND3 and IND4 (Table 3). Because of the space limitations, we did not provide the detailed analysis for RMSE values for IND4 for each country, but only the total. SM imputation is applied for 5 missing values, and other techniques are used for 31 imputations for IND3, i.e. 30 for IND4 (because IND4 is not measured for 2013).

Table 3: Total RMSE values

IND 3 - ICT goods imports						IND 4 – Electric power consumption					
CD	**SM**	**EM**	R	C-M	C-R	CD	**SM**	**EM**	R	C-M	C-R
1.498	**0.436**	**1.078**	1.574	1.454	1.588	358.18	**161.72**	**270.67**	450.33	1447.79	459.45

From the Table 3 we can see that SM expectedly proves to be the most accurate technique, since it is applicable only in a few cases and is measured as the average value between the two which exist. More importantly, EM proves to be the best technique among those which can be applied always. It is an interesting result, since we did not choose EM in none of the cases presented in the first analysis. Looking at Tables 1 and 2, it is obvious why we did not choose EM, since there is no explanation on such a decision. We can explain why we choose simple methods as CD, believing that we make smaller mistake by arguing that the trend has not changed over time. This analysis proves this to be wrong. Other techniques have higher errors, ranked differently for these two indicators. It is not possible to claim which one is the most inaccurate; it depends on the sample.

4. CONCLUSION

Using composite indices for assessing large phenomena and ranking the countries accordingly has been widely accepted. Even being aware of the shortages of composite indices, the race for a better country rank on different lists has taken its toll. Understanding the importance of composite indices today, many scholars try to deal with different methodological problems mentioned in this paper, all with the aim to create something maybe unreachable, and that is the objective and precise methodology for creating indices, in order to ensure the reliability of the results. The problem we address in this paper is the missing data. It is almost impossible to have complete datasets for all the countries observed according to different indicators that an index includes. To avoid exclusion of indicators or the countries observed, we need to opt for an imputation technique that will make the data complete, and countries performance possible to assess. In this paper we showed an overview of different imputation techniques, both single and multiple. Having different techniques among which we can choose is good, but we stay with a big problem of deciding which method to use to fill in empty data spaces. Luengo et al. (2012) considered this problem, choosing the best imputation method considering three groups of classification methods. We also try to provide an answer to this question in the Section 3 where we analysed two basic indicators needed for assessing technological capabilities of countries, which cannot be excluded from the analysis, and for which a lot of data is missing. On the examples of different countries we show how to select one appropriate out of six different single imputation techniques applied. Additionally, in order to strengthen the results and principles used in the first analysis, we performed an analysis on measuring accuracy of the applied techniques on another two indicators for the same countries for which the whole datasets exist, calculating the RMSE. This analysis enhances the claim that imputation of the missing data leads to doubtful results, enabling the manipulation.

It is important to emphasize that one imputation technique cannot always be applied for all the countries observed according to one indicator (sometimes even not for one country for the whole time period), but depends on the amount of the missing values and the nature of the existing data (e.g. whether the observed country has higher, lower or average values comparing to the others in the sample; whether we can catch the trend in the existing values which can be used for predicting the missing once), and depends on the sample (if the imputation technique is not separated from the sample). Besides these, it is important to notice that when we speak about the values for indicators for a period of time, we deal with time-series and not random values, and therefore need to be couscous when imputing. As mentioned in OECD-JRC (2008) there is no "a" method that should be used for imputing the missing values, but the method should be fitted to the characteristics of the missing information.

As Dempster and Rubin (1983, pp.3-10) remark, imputation "is seductive because it can lull the user into the pleasurable state of believing that the data are complete after all, and it is dangerous because it lumps together situations where the problem is sufficiently minor that it can legitimately be handled in this way and situations where standard estimators applied to real and imputed data have substantial bias." As Foa and Turner (2012) highlight, there is a serious problem of legitimacy when nations are rated based on estimated, rather than actual values. In such cases, it is very difficult to guard against challenges by critics from countries which are rated poorly, arguing that the scores are inaccurate. This is why the use of imputation is more common among academicians than among international organizations such as the United Nations, the European Commission, or the World Bank.

REFERENCES

Abdella, M., & Marwala, T. (2005, April). The use of genetic algorithms and neural networks to approximate missing data in database. *In Computational Cybernetics, 2005. ICCC 2005. IEEE 3rd International Conference on* 207-212. IEEE.

Archibugi, D., & Coco, A. (2004). A new indicator of technological capabilities for developed and developing countries (ArCo). *World development*, 32(4), 629-654.

Ayuyev, V.V., Jupin, J., Harris, P.W., & Obradovic, Z. (2009). Dynamic clustering-based estimation of missing values in mixed type data. Proceedings of the *11th International Conference on Data Warehousing and Knowledge Discovery - DaWaK '09* (pp. 366-377). Springer-Verlag Berlin.

Bandura, R. (2008). A survey of composite indices measuring country performance: 2008 update. *New York: United Nations Development Programme, Office of Development Studies (Working Paper).*

Chai, T., & Draxler, R. (2014). Root mean square error (RMSE) or mean absolute error (MAE)?–Arguments against avoiding RMSE in the literature. *Geoscientific Model Development*, 7(3), 1247-1250.

Cherchye, L., Moesen, W., Rogge, N., Van Puyenbroeck, T., Saisana, M., Saltelli, A., & Tarantola, S. (2006). Creating composite indicators with DEA and robustness analysis: the case of the Technology Achievement Index.*Available at SSRN 888461.*

De Mántaras, R. L. (1991). A distance-based attribute selection measure for decision tree induction. *Machine learning,* 6(1), 81-92.

Dempster, A.P, & Rubin, D.B. (1983). *Incomplete Data in Sample Surveys*, in Madow, W.G., Olkin, I., Rubin, D. (Eds),Sample Surveys Vol. II: Theory and Annotated Bibliography, Academic Press, New York.

Foa, R, & Tanner, J.C. (2012). *Methodology of the Indices of Social Development* (No. 2012-04). ISD Working Paper Series. Retrieved from http://hdl.handle.net/1765/50510

Filippetti, A., & Peyrache, A. (2011). The patterns of technological capabilities of countries: a dual approach using composite indicators and data envelopment analysis. *World Development*, *39*(7), 1108-1121.

Fujikawa, Y., & Ho, T.B. (2002). Cluster-based algorithms for dealing with missing values. *Knowledge Discovery and Data Mining Conference* (pp. 549-554). Springer, Berlin.

Grupp, H., & Mogee, M. E. (2004). Indicators for national science and technology policy: how robust are composite indicators?. *Research Policy*, 33(9), 1373-1384.

Hudrlikova, L. (2013). Composite indicators as a useful tool for international comparison: the Europe 2020 example. *Prague Economic Papers*, 22(4). doi:10.18267/j.pep.462

Little, R.J.A., & Rubin, D.B.(1987). *Statistical analysis with missing data*. John Wiley & Sons, New York.

Luengo, J., García, S., & Herrera, F. (2012). On the choice of the best imputation methods for missing values considering three groups of classification methods. *Knowledge and Information Systems*, 32(1), 77-108.

Lobato, F., Sales, C., Araujo, I., Tadaiesky, V., Dias, L., Ramos, L., & Santana, A. (2015). Multi-objective genetic algorithm for missing data imputation. *Pattern Recognition Letters*, 68, 126-131.

Nelwamondo, F.V., Mohamed, S., Marwala, T. (2007). Missing Data: A comparison of neural network and expectation maximization techniques. *Current Science* 3(11), 1514-1521.

OECD, & European Commission-Joint Research Centre. (2008). *Handbook on constructing composite indicators: Methodology and User guide*. OECD publishing.

Srebotnjak, T. (20 November 2001). *Multiple Imputations of Missing Data in the Environmental Sustainability Index - Pain or Gain?* United Nations Statistics Division, New York, USA in cooperation with the Center for International Earth Science Information Network (CIESIN), Columbia University, USA Retrieved from http://unstats.un.org/unsd/methods/wgci/ESIpubl.pdf

Zhang, S. (2011). Shell-neighbor method and its application in missing data imputation. *Applied Intelligence*, 35(1), 123-133.

THE CONJOINT ANALYSIS OF PARENTS' PREFERENCES TOWARDS CHILDREN'S PHYSICAL ACTIVITIES

Jelena Šormaz*, Marija Kuzmanović, Veljko Jeremić
University of Belgrade, Faculty of Organizational Sciences
*Corresponding author, e-mail: jelenasormaz91@gmail.com

Abstract: *Knowing parents' attitudes and preferences, as well as the challenges they face when choosing and organising their children's activities gives us the opportunity to perceive key problems in this field and to offer possible solutions. The right choice of the activities influences the correct development of children, in the present, as well as in the future. In this study it is shown how Conjoint analysis, which has rarely been used in this field, could help in obtaining detailed insight into the current situation, parents' priorities and wishes, but also potential problems that could arise. The study may help to draw attention to the importance of this field, to point out the possibility of its research through different disciplines and to initiate further efforts towards its comprehension and development.*

Keywords: *parents' preferences, physical activities, Conjoint analysis, children's development, health risks*

1. INTRODUCTION

Childhood presents the key period for creating a basis for the development of all aspects of personality, primarily through different activities and experiences. This is the period during which children are gradually forming their attitudes, interests, preferences, habits which usually stay present later in the future, with more or fewer alterations.

Naturally, parents have the pivotal role in the choice of children's activities in the early childhood. Later on in life, the importance of other factors prevails, such as friends, school, and media. With time, the latter becomes more and more influential.

We can conclude that there is a combination of different factors, pressures, and limitations that influences children as well as their parents when it comes to deciding which activities the child should choose. Lack of time and financial resources, peer and media pressure represent just a few among the challenges they face on a daily basis.

The aim of this paper is to examine how they cope with these challenges, which criteria they take into account when choosing children's activities and whether the parents are aware of the importance that each activity has on their child's development. Also, we would like to find out what potential problems could arise when it comes to choosing and organising those activities. If we could understand parents' preferences, as well as the challenges they face, we would be able to point out some major issues and suggest potential solutions.

First, we will talk about the importance of the physical activities in childhood and their impact on developing permanent healthy habits. Moreover, we will discuss the possible consequences of inactivity, as well as certain limiting factors that impede parents from organising their children's activities. Also, we are going to introduce Conjoint methodology, used for obtaining the results of our survey, that will also be presented in more details within this part. Afterwards, we need to analyse the obtained results. First of all, we will get to know our sample and its characteristics. Later on, we will talk about attitudes and experiences parents shared with us in the second part of the survey. Lastly, we will present the results of the Conjoint analysis, discussing the most important conclusions about respondents' preferences. The last part of the paper is dedicated to the discussion of the new findings. We have tried to give a comprehensive overview of the key problems, their possible solutions and potential recommendations for the future research.

2. THE IMPORTANCE OF PHYSICAL ACTIVITY

The way children spend their leisure time has changed over time. Electronic entertainment represents one of the indoors activities, which takes up to 7.5 hours a day of children's free time (Hofferth & Curtin, 2003). In the last decade, the use of electronic devices increased dramatically. Even though the time dedicated to watching television is still significant, we are now witnessing the increase of usage of other media (Hofferth &

Sandberg, 2001). It is alarming that this way of life leads to the increase of chronic diseases. It is significant to emphasise that this happens despite the high level of children's participation in organised physical activities. A lot of children practise different sports, but it might be possible they are not aware of the relevance of physical activities. Therefore, they can't form healthy habits in the right way.
In our research, we decided to consider parents whose children attend primary school as our target group because the period of the primary school is vital for children's personality development. Furthermore, it enabled us to examine how physical activities are combined with school responsibilities since parents often have the tendency to believe that the school results and the level of physical activities are conflicting. In other words, they think the more time children dedicate to physical activities, the poorer results they will achieve at school (Inspiring Children's Physical Activity: Exploratory Research with Parents, 2003). This shows us why it is important to explain to parents that this is a mistake and physical activity, in fact, has a positive impact on different aspects of a child's life, even on the development of their intellectual skills and on school results presently, as well as in the future.

The beginning of primary school (between six and eight years) represents the crucial period for the development of physical capabilities (Dauer & Pangrazi, 1989; Fox, 2009) during which children form habits related to physical activity and nutrition (Jago et al., 2005). It has been proven that the habits formed during childhood stay present during adulthood as well (Malina, 1996; Twisk et al., 2000). Consequently, the acquisition of healthy habits in the early childhood has had a tremendous significance and impact on children's health in the present, as well as in the future. Adequate participation in physical activities during childhood and adolescent period represents the key factor for keeping good health in the long term (Trost, 2010).

Having in mind broad prevalence of physical inactivity and constant spreading of the obesity problem (Ogden et al., 2008), the promotion of regular activity among the youth has become the top priority of health organisations worldwide. Establishment of healthy behaviour in the early childhood constitutes a pivotal role for future habits and activities. Encouraging physical activity, especially outdoor, could be the key factor in the struggle against health risks caused by modern lifestyle.

Parents have the possibility to influence the children's behaviour, and they have a pivotal role in encouraging their physical activity (Brockman et al., 2009). The research have shown that this encouragements, together with parents' logistical support (providing resources and equipment for the activities, driving or accompanying their children to the venue where the activity is taking place), has the major impact on the children's level of activity (Davison et al., 2003; Hennessy et al., 2010; Jago et al., 2010). Bearing in mind the increase of problems with overweight and obesity, the extent to which parents influence their children's habits concerning nutrition, physical activity and passive ways of spending free time (watching television, using computers, etc.) became the issue of special interest (Pocock et al., 2010).

However, we have to be aware of the factors that limit the possibility to take part in different activities. Some of the factors parents identified as limiting were lack of time (Hesketh et al., 2005; Mitchell et al., 2011), lack of resources and excessive costs (Mitchell et al., 2011; Smith, 2005), security, violent peers, as well as the peers' pressure to sedentary activities (such as watching television and computer usage), lack of adequate program opportunities and offers (Smith, 2005) and a great distance to the venue of the training (Hesketh et al., 2005). Parents' experiences show that these obstacles make it difficult or even impossible for them to involve their children in different activities.

Since the sedentary way of life has become more and more prominent in the modern life, we can notice the increase of its consequences on health and other aspects of children's personality. It is important to point out these consequences continue later on in life because the habits acquired in childhood continue in the mature age as well. That is one of the main reasons why we decided to focus on the physical activity in our research.

Understanding the social and environmental factors that influence physical activity play vital role in developing effective measures and initiatives for increasing the level of children's and adolescent's activity. On the one hand, our results could encourage parents to pay more attention to this topic and help them to get a broader insight into its importance. At the same time, these results can also be beneficial to schools, relevant ministries, and organisations when it comes to starting different initiatives. They could help them create innovative programs and focus on the key matters revealed during the research.

3. METHODOLOGY AND RESEARCH

3.1. Conjoint analysis

Our goal was to determine which factor is the most important between different types of training, as well as which combination of characteristics is the most appealing one for parents. To be able to answer these questions, we used Conjoint analysis, which reveals respondents' preferences through the simulation of the real problem of choice.

The previously mentioned term was introduced in 1978 by Green and Srinivasan. However, there isn't a clear-cut definition of this term, but several are provided. Hair (Hair et al., 1998.) defined it in his paper saying that 'Conjoint analysis is a multivariate technique used specifically to understand how respondents develop preferences for products or services. It is based on the simple premise that consumers evaluate the value of a product or service by combining the separate amounts of value provided by each attribute.' Sudman and Blair (1998) pointed out that it must be regarded as a type of 'thought experiment' designed to show how various elements of products or services (price, brand, style) predict customer preferences for a product or service.

The central assumption of the decomposition approach is that consumers evaluate overall utility of product/services combining part-worth utilities of various levels for each attribute which describe a certain product. Those partial utilities are defined as numeric values that show the level of appeal of different characteristics of product/services. When a consumer chooses between different products, they don't observe only one isolated characteristic, but they make their decision by observing (perceiving) and analysing its characteristics all at once. The name of the method comes from that fact – CONsidered JOINTly (Kuzmanovic, 2006).

The researcher defines some key attributes of the analysed entity. Then he needs to choose several different levels, variation for each attribute. Each combination of the different levels of attributes forms one profile or concept (Kuzmanovic, 2006).

Two main goals of the Conjoint Analysis are:

- To evaluate the contribution (influence) of each attribute on consumers' overall preferences
- To create a valid model of consumers' judgment which would be helpful in forecasting his reactions to the changes in the characteristics of the existing product or introduction of a new product to the market.

This method represents very well real conditions and the consumers' behaviour on the market. It simulates the whole process of choice in a certain way. Upon completing the survey, the respondent has to put themselves in the position of a consumer and to truly analyse and evaluate all of the presented offers according to their preferences, needs, and priorities.

The process of implementation of the Conjoint analysis study consists of the following key steps:

1. Attribute List Formulation - A business problem is defined, and an attribute (features) list, as well as their performance levels, is developed to study the problem.
2. Data collection - Respondents are asked to express the trade-offs they are willing to make among product features by rating, sorting or choosing among hypothetical product concepts.
3. Utility calculation - A set of preference values (also called part worth utilities or part-worths) is derived from the interview data; they reflect the trade-offs each respondent has made.
4. Market Simulation.

Owing to the Conjoint Analysis, we can understand which characteristics are the most important to them when choosing a product/service. Furthermore, we are able to see which level of each attribute is the most appealing to them. In this way, we are able to adjust the offer to their needs and preferences. We can identify the key factors which they pay attention to the most and which affect their decisions and choices. In addition, we can modify them in order to create the optimal mix of characteristics. In that way, we maximise consumers' satisfaction, as well as we maximise our opportunities/income/success. We get a realistic image of the needs and wishes on the market.

This method has rarely been applied in the field of children's development. However, considering the fact that our main goal is to get an insight into parents' preferences, it is undoubtedly suitable for this research.

What we are expecting to achieve with this choice of method is to shed the light on the new possibilities a contribution that similar multidisciplinary research could bring, broadening the knowledge and understanding of this field.

3.2. Research

During October 2015, 109 parents participated in the survey. The surveys were distributed online, using various social networks, as well as in the paper version in several primary schools in Serbia.

We decided to focus on the parents whose children attended primary schools since we have learned from the referenced literature that this was the critical period for children's development. The children included in this study were between 6 and 14 years old.

The survey consisted of two parts. In the first part, demographic questions and issues that concern parents' attitudes and experiences towards their children's physical activity were included. The second part comprised 16 scenarios analysed by the Conjoint analysis. Each scenario represented the combination of various levels of seven different attributes. All attributes with all their levels are the following:

- Type of sport:
  - Individual
  - Team
- Contact:
  - With contact
  - Without contact
- Training intensity:
  - High
  - Medium
  - Low
- Frequency of training:
  - Once a week
  - 2 – 3 times a week
  - More than 3 times a week
- Parents involvement:
  - Children need to be accompanied by their parents to the venue
  - Children don't need to be accompanied by their parents to the venue
- Possibility of competition:
  - Existing
  - Non existing
- Monthly price:
  - 10% above the average
  - Average
  - 10% below the average

Parents were asked to evaluate each offer of training (5-I like it very much, ..., 1-I do not like it at all) based on their preferences and priorities.

4. RESULTS

As it was expected, mothers represented the majority of the sample. 88 mothers and 21 fathers have completed our surveys. 88 girls and 70 boys have been included in the research. The average age of children was 10.97 years. 74.3% of parents were from the territory of Belgrade, and the remaining 25.7% came from all over Serbia, mostly from the province of Vojvodina, 16% of them. An average household income was shown to be on a rather high level, as 25.7% of parents said their average monthly income was 120.000 RSD.

In the following part of the survey, we focused on children's physical activity. The results have shown that 75.6% of children practice some kind of sport, and the team sports stand out as the most popular ones. Figure 1 illustrates the distribution of children's participation in different types of sports.

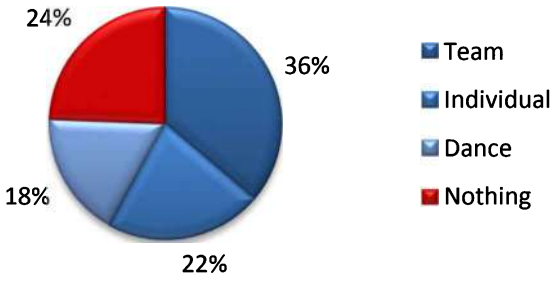


Figure 1: Children's organised physical activities

It has also been shown that there is statistically significant difference ($p<0.05$) when it comes to comparing the level of activity between boys and girls, girls being slightly less active than boys.

It was interesting to examine whether there has been some statistically significant difference between the level of activity of parents and their children. It has been found that such difference exists ($p<0.01$) and that there is a direct correlation between these two variables (parents' level of activity and child's level of activity). In other words, if parents practise, or had practiced some kind of sport, there is much greater possibility for their children to practice some sport, as well. Numerous research has confirmed this pattern – the more parents are active, the more their children will also be (Moore et al., 1991; Anderson et al., 2009).

Some of the questions concerned the parents' satisfaction with the level of their children's physical activity. The obtained results indicate that the parents are to a great extent satisfied with this level, since more than 78% of them declared as satisfied, as opposed to 5% of highly unsatisfied respondents. Moreover, it has been shown that there is no statistically significant difference between the extent of satisfaction between the boys' parents and girls' parents. It is interesting to mention that some research have shown that there has been noticed a lower level of activities among girls, but their parents did not express any discontent, since they considered it natural for girls to lose their interest in sport at some point, while the boys were more forced to be physically active (Anderson et al., 2010). Besides, it has been noted that parents who are or were actively practicing some kind of sport were somewhat more satisfied with the level of their children's activity, which is another proof that the physical activities of parents and their children are directly correlated.

The parents who were not entirely satisfied were asked to evaluate the influence of certain factors that could be responsible for children's insufficient activity. Each factor was evaluated using the 1 – 4 scale, where 1 represented 'completely without influence', and 4 'highly influential'. The results show that the lack of financial resources was identified as the greatest problem, since almost 45% of parents considered this factor as highly influential. The lack of child's free time was recognised as another important obstacle. It has been shown that the lack of adequate programs was considered as one of the least influential factors, which is consistent with the results of other similar research around the world. In these research respondents also considered the offer of programs quite satisfying, while they saw the price as the greatest obstacle (Inspiring Children's Physical Activity: Exploratory Research with Parents, 2003). The lack of child's interest was shown to be the least influential, but it is important to point out that generally there are no significant differences in the extent of influence. What we found interesting was the fact that there was statistically significant difference ($p<0.05$) between the mothers' and fathers' responses. Fathers considered the lack of parents' time to be far more influential than mothers did while for mothers the lack of financial resources represented a more important obstacle than it was for fathers.

Since the finance was overall seen as the most influential factor, we were curious to see how much money are parents willing to devote to children's training on a monthly basis. The range of the amount of money was between 0 and 15 000 RSD while the average amount was 3945.4 RSD. It has been demonstrated that there was a statistically significant difference between the sums. The respondents from Belgrade were willing to invest, as opposed to the respondents from the rest of the country. The results of t-test have shown that the value of statistic was $t = 2.403$, while the p-value was $p = 0.018$ ($F = 5.416$, $p = 0.022$). The residents of Belgrade were on average willing to invest 4258.2 RSD while this amount was 2928.7 RSD when it comes to the respondents outside the capital.

Taking into account the challenges parents are facing in everyday life, such as stress, a multitude of obligations and responsibilities, etc., we wanted to examine to which extent these conditions influence the choice of children's activities. Foreign research has shown that parents have less time for organising and participating in those activities. Furthermore, some parents have admitted that sometimes they prefer that their children are less active. When they return home from work, they do not need any additional activities,

and consequently, it is easier for them that their children spend time using a computer or watching television (Inspiring Children's Physical Activity: Exploratory Research with Parents, 2003). However, although sometimes it seems easier to turn to unhealthy habits, parents have the responsibility to guide their children towards a healthy lifestyle (Sallis et al., 2000).

Parents completing our survey were asked to say whether they agreed with the given statements considering the difficulties they could have in organising and arranging children's activities. 52.3% of parents admitted they find it difficult to cope with this task and that they found it highly challenging while the rest of 47.7% of the respondents stated that they were not perceiving it as a difficulty.

After gaining insight into parents' experiences and opinions, we turned to Conjoint analysis in order to comprehend the way they choose activities for their children. We wanted to learn which criteria were the most important to them and how their priorities and preferences had reflected to their final choice.

Using Conjoint method, we came to a conclusion that the most desirable combination of characteristics which forms the optimal training type is the following:

- Team sport
- Without contact
- High intensity
- 2-3 times a week
- Children do not need parents' help to get to the venue
- Possible competitions
- Monthly price 10% above average

Among the list of the variables, the most significant ones that stand out and influence parents' choices the most are the frequency of training, price per month and training intensity. The least important one for parents is the question of a contact or non-contact sport. In the following graph (Figure 2) we can see the average importance of each variable.

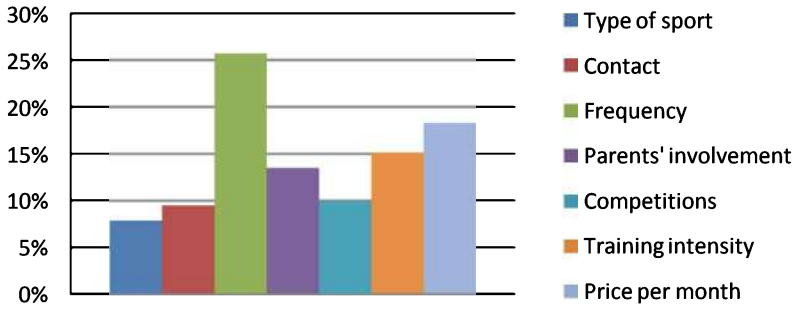


Figure 2: Average importance of attributes on aggregated level

As we can see in the following graph showing the partial utilities for each level of attributes (Figure 3), parents prefer training 2-3 times per week, and they are very sensitive to changes of this level. Furthermore, it is very important for them that children can go alone to the venue where the training is held and that the price is below the average. If these levels change, the attractiveness of the offer reduces.

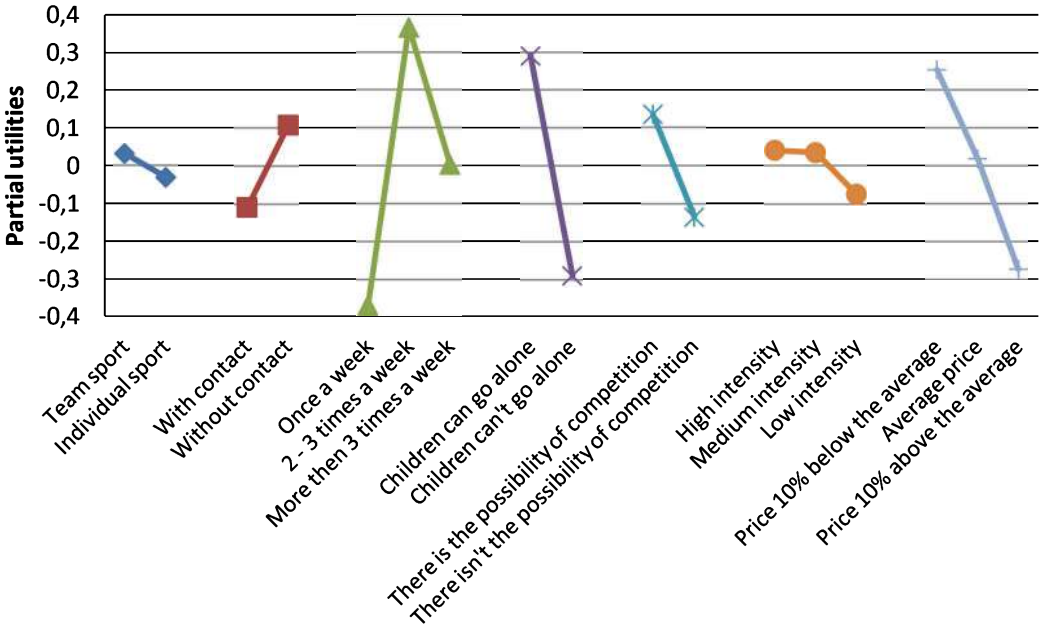


Figure 3: Partial utilities of levels of attributes

Values of Pearson's and Kendall's coefficients confirm the high level of significance and credibility of results. ($R=0.987$, $p<0.01$; $\tau=0.929$, $p<0.01$).

4. CONCLUSION

This paper deals with a very current topic in order to indicate the importance of physical activity during childhood, family support and encouragement in the process of child's development and the problems arising in this field.

Although in Serbia is not paid much attention to this issue, numerous research with a different focus (health, family relations, academic achievements, etc.) has been conducted around the world. What makes our research stand out among other similar ones is the fact we used Conjoint analysis to determine parents' preferences, which enabled us to reveal some attitudes and opinions that were not obvious instantaneously.

We found out that parents were mostly satisfied with the level of their children's activity, although they were worried about the sedentary way of life. Furthermore, the research has demonstrated that most parents find the lack of financial resources as the most limiting factor when choosing activities for their children.

Bearing in mind the conditions brought by the modern way of life – fast technological changes influencing all aspects of life, more stress and pressures from the environment, it is extremely important to draw the attention of parents to the significance of dedicating their time, resources and effort to their children's activities. Moreover, it is essential to help them organise and use their free time, as well as their children's free time, in the most effective way and, since the focus of the research was directed towards physical activity as one of the most important and simultaneously the most endangered nowadays, it is also vital to make an influence on parents and children so that they could develop and maintain their healthy habits. When it comes to parents, one of the possible strategies could be using websites, specialised magazines, and social networks to promote not only the positive effect of sport on health but also the risks of constant inactivity. Furthermore, school programs should encompass informing and educative initiatives dedicated to physical activity. The sport should be presented as a healthy habit, an essential part of everyday life, and not only as a secondary competitive activity.

Analysing the results, we came to the conclusion that if we want to make our children more active, what we need to do is to start sports programs that would not be financially demanding, making them affordable to the larger number of children.

Although we came to some important findings, there is still a wide range of opportunities when it comes to investigating this topic. For instance, it would be recommendable to include younger children in the future research. One of the reason is the fact that the processes of personality development begin long before primary school, and so we would be able to examine the effects of different factors present in the earlier period, which would give us the opportunity to react on time according to those potential new findings. Another important benefit would be the possibility to compare preschool and school children and to discover

potential differences and its causes. Moreover, focusing only on school children, we missed out the opportunity to investigate the influence of younger or older children on their parent's opinions and family dynamic in general.

Also, it would be desirable that the future research cover greater and more heterogeneous sample, not only to include the children of different age but also to reach more children out of Belgrade, so that we could have more comprehensive insight into the current state in this field.

Apart from that, having in mind the modern way of life, it would be truly prudent to thoroughly examine children's relation to the new media, especially the time they dedicate to the new technologies and its influence on different life aspects.

In conclusion, we want to emphasise once more that this is the topic that demands attention due to its importance and influence in present, as well as in the future, when we would be able to perceive the consequences of the present (in)activity. This is why it is crucial to deal with this problem now, to dedicate our attention to it and resources if we want to ensure the proper development of the new generations, in spite of the increasing challenges.

REFERENCES

Anderson, C., B., Hughes, S., O., Fuemmeler, B., F. (2009). Parent–child attitude congruence on type and intensity of physical activity: Testing multiple mediators of sedentary behavior in older children, *Health Psychology*, Vol 28(4), Jul, 428-438. Retrieved from http://dx.doi.org/10.1037/a0014522 (25.09.2015.)

Brockman, R., Jago, R., Fox, K., R., Thompson, J., L., Cartwright, K., Page, A., S. (2009). *Get off the sofa and go and play: family and socioeconomic influences on the physical activity of 10–11 year old children*, BMC Publ Health, 21:253.

Dauer, V., P., Pangrazi, R., P. (1989*). Dynamic Physical Education for Elementary School Children*, 9th edition. New York: Macmillan

Davison, K., K., Cutting, T., M., Birch, L., L. (2003). Parents' activity-related parenting practices predict girls' physical activity, *Med Sci Sports Exerc*, US National Library of Medicine, National Institutes of Health, 35 (9):1589–1595.

Fox, K., R.(2009). How to help your children become more active. In Gonzalez-Gross M. (Ed.), *Active healthy living: A guide for parents*, Brussels: Coca Cola Europe, 52–67.

Hair J.F., Anderson, R.E., Tatham, R.L., Black, W.C., (1998). *Multivariate Data Analysis*, 5th Edition, Upper Saddle River, New Jersey, Prentice Hall International

Hennessy, E., Hughes, S., O., Goldberg, J., P., Hyatt, R., R., Economos, C., D. (2010). *Parent–child interactions and objectively measured child physical activity: a cross-sectional study*, IJBNPA, 7:71.

Hesketh, K., Waters, E., Green, J., Salmon, L., Williams, J. (2005). Healthy eating, activity, and obesity prevention: a qualitative study of parent and child perceptions in Australia, *Health Promot Int*, US National Library of Medicine, National Institutes of Health, 20:19–26.

Hofferth, S., and Sandberg, J. (2001). Changes in American Children's Time, 1981-1997. In S. Hofferth & T. Owens (Eds.), *Children at the Millennium: Where did we come from, where are we going?*. New York: Elsevier Science.

Hofferth, S., L. and Curtin, S., C. (2003). Leisure Time Activities in Middle Childhood, *Positive Outcomes Conference*, Washington, DC, March 12-13

Inspiring Children's Physical Activity: Exploratory Research with Parents Prepared for: U.S. Department of Health and Human Services Centers for Disease Control and Prevention VERB™ Campaign, Prepared by: SpencerHall, May 2003

Jago, R., Baranowski, T., Baranowski, J., C., Thompson, D., Greaves, K., A. (2005). BMI from 3–6 years of age is predicted by TV viewing and physical activity, not diet., *Int J Obes Relat Metab Disord*, US National Library of Medicine, National Institutes of Health, 29(6):557–564.

Jago, R., Davison, K., K., Brockman, R., Page, A., S., Thompson, J., L., Fox, K., R. (2010). Parenting styles, parenting practices, and physical activity in 10- to 11-year olds, *Prev Med*, US National Library of Medicine, National Institutes of Health, 52:44–47.

Kuzmanović, M. (2006). *Kvantitativne metode u marketingu: Primena Conjoint analize*, Društvo operacionih istraživača, Beograd

Malina, R., M. (1996). Tracking of physical activity and physical fitness across the lifespan. *Res Q Exerc Sport*,US National Library of Medicine, National Institutes of Health, 67(3):48–57.

Mitchell, J., Skouteris, H., McCabe, M., Ricciardelli, L., A., Milgrom, J., Baur, L., A., Fuller- Tyszkiewicz, M., Dwyer, G. (2011). Physical activity in young children: a systematic review of parental influences, *Early Child Dev Care*, US National Library of Medicine, National Institutes of Health, 82(11):1–27.

Moore, L.L., Lombardi, D.A., White, M.J., Campbell, J.L., Oliveria, S.A., Ellison, R.C. (1991). Influence of parents' physical activity levels on activity levels of young children., *The Journal of Pediatrics*, Feb;118(2):215-9.

Ogden, C., L., Carroll, M., D., Flegal, K., M. (2008). High body mass index for age among US children and adolescents, 2003-2006, *JAMA*, US National Library of Medicine, National Institutes of Health, 299:2401-2405.

Pocock, M., Trivedi, D., Wills, W., Bunn, F., Magnusson, J. (2010). Parental perceptions regarding healthy behaviours for preventing overweight and obesity in young children: a systematic review of qualitative studies, *Obes Rev*, US National Library of Medicine, National Institutes of Health;11(5):338-353.

Sallis, J., F., Prochaska, J., J., Taylor, W., C. (2000). A review of correlates of physical activity of children and adolescents, *Med Sci Sports Exerc*, US National Library of Medicine, National Institutes of Health, 32(5):963–975.

Smith, M., (2005). Parental influences on the physical activity behaviour of children of various ethnic backgrounds, *Res Q Exerc Sport*, US National Library of Medicine, National Institutes of Health, 76(1):50–51.

Sudman, S., Blair, E. 1998. *Marketing research: A problem-solving approach*. New York: McGraw–Hill.

Trost, S., G. (2010). *Discussion paper for the development of recommendations for children's and youth's participation in health promoting physical activity*. Retrieved from http://espace.library.uq.edu.au/view/UQ:190465. (25.09.2015.)

Twisk, J., W., Kemper, H., C., G., van Mechelen, W. (2000). Tracking of activity and fitness and the relationship with cardiovascular disease risk factors. *Med Sci Sports Exerc*, US National Library of Medicine, National Institutes of Health, 32(8):1455–1461.

COMMUNICATION MANAGEMENT 110

ONLINE COMMUNICATION OF CORPORATE SOCIAL RESPONSIBILITY 111
Malinović Sonja, Vlastelica Tamara, Cicvarić Kostić Slavica

MANAGING DIGITAL MARKETING COMMUNICATION IN ORGANIZATIONS IN SERBIA 119
Veselinović Tamara, Vlastelica Tamara, Lalić Danijela

SOCIAL MEDIA AND PUBLIC SECTOR - THE EXPERIENCE OF THE USE OF SOCIAL MEDIA IN STATE ORGANIZATIONS AND SERBIAN DEFENSE STRUCTURE 125
Đurić-Atanasievski Ksenija, Bobar Zoran

RESHAPING THE FUTURE OF COMMUNICATION BY RESHAPING CRM 133
Jugovic Tijana, Milosev Dejana, Vukmirovic Valentina

BRAND DESIGN IN FUNCTION OF SUSTAINABLE CUSTOMER COMMUNICATION DEVELOPMENT 139
Kostić-Stanković Milica, Vukmirović Valentina

EFFECTS OF BUNDLING NON-COMPLEMENTARY PRODUCTS – COMMUNICATION PERSPECTIVE 146
Aćimović Vera, Cicvarić Kostić Slavica, Vlastelica Tamara

COMMUNICATION MANAGEMENT

ONLINE COMMUNICATION OF CORPORATE SOCIAL RESPONSIBILITY

Sonja Malinović[1], Tamara Vlastelica[2], Slavica Cicvarić Kostić[3]
[1] SHARE Foundation, sonja.malinovic@yahoo.com
[2,3]Faculty of organizational sciences, University of Belgrade

Abstract: *The number of internet users is continuously increasing, and more companies recognise the significance of online visibility and digital media in communication with the stakeholders. The use of digital media in communication has affected the way the stakeholders get the information about companies and the way the companies are involved in the corporate responsibility. The subject of the research in this paper is online tools and digital media usage in communicating corporate social responsibility. The focus is on digital media special features, which due to their wide application and rapid development contribute to communicating the social responsibility. By employing a comparative case study, the paper analyzes the usage of digital media in promotion of social responsibility of the companies in different industries. Based on the results, the specific features of this form of communication are identified, and guidelines for improving online communication of corporate social responisibility are defined.*

Keywords*: corporate social responsibility, digital media, online communication*

1. INTRODUCTION

Corporate Social Responsibility (CSR), defined as “a commitment to improve community well-being through discretionary business practices and contributions of corporate resources” (Kotler & Lee, 2007), takes a prominent place in the global corporate agenda in today’s socially responsible business environment.

More than ever, companies invest significant resources in the form of starting different social and ecological initiatives – from investments in the local community, and reduction of greenhouse gas emissions, to socially responsible business in the area of employment, acquisition, product design, production, etc. These unprecedented efforts in the area of socially responsible business are not guided solely by the ideological attitudes of companies, but also by financial gain that could be realised through these endeavours. Many top managers and experts in the area of CSR point out that corporate social responsibility creates a unique business value in a number of ways – it has a positive effect on the reputation, employees’ moral, and strengthens the competitive advantage (Bonini et al., 2009). Establishing good relationships with the stakeholders is the key to successful business, and CSR has a special ability to additionally strengthen and preserve those relationships.

Corporate social responsibility depends on the stakeholders’ awareness of the socially responsible activities of a company. However, empirical studies have discovered that the awareness of the socially responsible business of a company among the external stakeholders, but also the internal stakeholders, is usually low, hence represents the key obstacle to the company’s experiencing the advantage of its CSR programmes (Sen et al., 2006). This is why it is necessary to create the constituents’ awareness of the strategy and objectives of the social responsibility of the company, as well as of the achieved results of the realised socially responsible activities.

It has shown that the outdated practice of communicating social responsibility, which meant printing brochures, flyers, and prospectuses, with the same messages for all the stakeholders didn’t have satisfying results, so the companies across the world started taking an online approach establishing a two-way communication on the global level whereby providing personalised messages for each group of stakeholders. A successful applying of this approach requires extensive knowledge of digital media channels, their advantages and risks, and this is why a special segment in the paper is dedicated to them in particular.

The paper presents analysis of digital media usage in communicating CSR of the companies from different industries and with different strategies, it shows in which way the communication of this concept is improved through using online approach. Furthermore, potential risks will be pointed out, as well as guidelines for the additional improvement of this process.

2. COMMUNICATING CSR

Today, more than ever before, the public expects from the corporate sector to have a more proactive role in social, environmental and economic development of the society. On one hand, people are more aware of ethical issues and more sensitive to their occurrence. On the other hand, the impact which corporate business operations have on people's quality of everyday life and society as a whole has increased significantly (Dahlsrud, 2008; Carroll, 1999). In order to be socially responsible each company needs to fully understand how its business activities affect the local community in which it operates. The concept refers to the integrated concerns about society and environment in day-to-day corporate activities (European Commission, 2003). With this in mind, companies should consider themselves as equal members of the community who have certain duties and responsibilities (Vlastelica Bakić et al., 2015).Elaborated description of the most important CSR concept definitions used in both academic literature and practice is given by the author Vlastelica Bakić (2012).

As it is mentiond above, stakeholders awareness and perception of the CSR strategy, programs, acitivities and results is of great importance. In order to inform stakeholders, companies use various media for communicating CSR. It has shown that tradional media are less effective, and the companies icreased their usage of online communication tools in CSR communication. Online communication requires extensive knowledge of digital media, their features, as well as their advantages and risks.

Digital media become a powerful channel for informing of stakeholders not only about company's offering, but also about other business issues, such as CSR programs and activities. The most common digital media used by companies include website, social media (Facebook, Twitter, YouTube, LinkedIn) and corporate blog (Georgescu&Popescul, 2015; Bagozzi et al., 2012; Tate, 2010; Safko&Brake, 2009; Scoble&Israel, 2006).

3. METHODOLOGY

The method employed in this paper is comparative case study analysis. Comparative case study represents a research method which as its goal has the identification of similarities and differences in processes, events and activities which are the subject of the analysis (Khan & VanWynsberghe, 2008). The following part will analyse the usage of digital media channels by companies Unilever and Starbucks in communicating corporate social responsibility.

The criteria used while choosing these companies are the following: Unilever is the leader in its industry for the year 2014 according to Dow Jones Sustainability index (http://www.sustainability-indices.com/review/industry-group-leaders-2014.jsp). This company is the first on the list of the 100 best European companies in online communicating corporate social responsibility (http://www.lundquist.it/6th-csr-online-awards-white-paper?cat_slug=whats-on/white-papers). Starbucks is one of the most successful multinational companies in the world and is on the Forbs list of the 100 most valuable world brends (http://www.forbes.com/companies/starbucks/). The companies in question belong to different industries, with different strategies for communicating corporate social responsibility, which makes them suitable for comparative analysis.

The sources used during the analysis of communicating corporate social responsibility are the official websites, verified Facebook, Twitter, LinkedIn and YouTube profiles of these companies, as well as the official corporate blogs.

4. ANALYSIS OF COMPANIES

4.1. Unilever Company

Unilever Company is one of the biggest producers of the consumer goods. With 400 brands and products which are sold in more than 190 countries, Unilever products are used by around two billion people every day across the world. According to the data available on the official website of the company (http://www.unilever.com) the company achieved a turnover of 48.4 billion Euros in 2014, and employs more than 172,000 people.

4.1.1. Unilever Company Website

What is noticeable when accessing the corporate website of the company (http://www.unilever.com/) is that the pieces of information regarding sustainable development pervade a number of the website segments. For example, in the "About" segment, in addition to information about business and brands, there is also a description of the responsible business of the company. On the same page the users can access the links which directly lead to the special page about sustainable development.

Even in the vision itself which is quoted in the "About" part, the company commits to doing business responsibly and promoting sustainable development, which clearly indicates the level of determination in the company's way of doing business. In purpose and principles ("Purpose & principles") description Unilever emphasises the importance of responsible and fair behaviour towards all of the stakeholders – the employees, suppliers, business partners, the local community, etc., and in the graphical representation of the business model the central part is occupied by sustainable development.

The recognisable logotype of the company, created in 2009, is composed of a multitude of symbols. Some of them, like the symbol of the bee, points to dedication of the company to influence the environment protection, reduce waste, and do business in a sustainable manner, which is very innovative in a sense of communicating corporate social responsibility.

A special page of the website is dedicated to sustainable development, to which leads a special tag in the horizontal navigation named "Sustainable living". The first part encourages interaction with the stakeholders in a number of ways. By clicking on the **"**News**"** field the stakeholders can get informed on the latest news in the area of corporate social responsibility. The news is divided into videos, press releases, and speeches and interviews. The company enables the users to share the news on the most popular social networks, but the downside of the page is that it is not possible to leave a comment. By clicking on the "Join In" field, the users can get more information on the CSR campaigns and areas in which the company invests its resources. In addition to textual information and video material, the company provides the possibility for the users to, by filling in a questionnaire "What is important to you", give their opinion on which aspect of environment protection is the most important for them. After voting, stakeholders can see the currents results of the voting. In this way, the company establishes a two-way communication, interaction which is in the most cases hard to establish through the channels of communication such as web sites. Also, the users can subscribe for the company bulletin which is completely dedicated to corporate social responsibility. By clicking on the field "What matters to you", the users can get answers to the most frequent questions. This points to how much the company takes into account the stakeholders' needs and tries to answer all of their requests.

The other part of this page is called "Sustainability Living Plan", and it describes the plan of the company to accomplish the vision of doubling the business, along with reducing the environmental impact and raising the positive impact on the society development until 2020. Moreover, at one's disposal is the link leading directly to company strategy regarding the responsible business. The three pillars of the sustainable business of the company, i.e. the three most important objectives within "Sustainability Living Plan" represented in three different segments are: improving health & well-being, reducing environmental impact and enhancing livelihoods.

4.1.2. Unilever Company Facebook Page

Unilever official Facebook page (https://www.facebook.com/unilever) has over 3 million users. The company posts around two times per week, and every post gets around 28,900 likes, comments, and shares in average, which points to extremely high level of engagement among the stakeholders. Through the posts analysis it is noticeable that the company intensively communicates the sustainable business subjects. In addition to textual information the posts contain videos, links, and photographs. There is a room for improvement in the way of addressing the customers, namely, the posts themselves don't directly call for the users' egagement, which would be achieved, for example, through asking them questions.

4.1.3. Unilever Company Twitter Account

The official Unilever Company Twitter account is called Unilever News (https://twitter.com/unilever), which is followed by 91,348 users. In a month's time period, the company tweets around 48 times, which is averagely 1.6 tweets per day, whereas the main competitor, Procter&Gamble Company, during the same time period tweets as many as 7.7 times a day. The more intensive competitor's communication on this social network has certainly paid off, since it has a few tens of thousands followers more than Unilever.

Unilever Company shares content and is involved in the subjects with the key words #marketing, #business strategy, #sustainability, #SustLiving, which points to the fact that the posts are mostly about sustainable

development, just as in the case on the website. The way of communication is very similar to that through the Facebook page, interesting pieces of information regarding current campaigns are predominant, and interesting data from the CSR report are picked out, and what is characteristic is that in addition to textual statement, posts also contain photographs, videos, or links. However, just as on the Facebook page, what is missing is addressing the users directly through asking questions or their opinion which would additionally encourage their engagement. In addition to the official account, Unilever has a number of other Twitter accounts, which can be confusing for the users.

4.1.4. Unilever Company YouTube Channel

Unilever has its official YouTube channel (https://www.youtube.com/user/Unilever), and multitude of other brand channels (such as Dove, Knorr, etc.). On the official channel, the users can access play lists with video material regarding company's business presentation, as well as sustainable business. How important for Unilever this platform is as means of communicating corporate social responsibility states the fact that this channel has more than 417,000 subscribers, which is significantly higher number than that of Proctor&Gamble Company's.

The significance of the YouTube channel for Unilever Company is also stated in the fact that it has presented its largest socially responsible project "Project Sunlight" through a video on its official channel on precisely this social network. The project aims at encouraging people to adopt the sustainable way of life. It was started in 2013, and in 2014 the name of the project has been changed to "brightFuture". Within this project, the company has put at the users' disposal a large number of online activations enabling them to be involved in various ways and for the sake of contributing to the sustainable way of life – they can directly donate the resources for a certain campaign or simply fill in a form and give their voice to support a certain action, they can share the company film about the project through social networks, post their videos, and share the ideas for the new ways of sustainable living on Facebook and Twitter by using hashtag #brightFuture.

For the promotion of the video which presents Project Sunlight, the company used Trueview, a true innovation in YouTube advertising. What distinguishes Trueview from the classic forms of advertising on this social network is that the viewers have the option to watch the whole video or to "skip ad" after 5 seconds, just like with the classic advertising, but the advertisers are paid only if the viewers watch the whole video ad.

4.1.5. Unilever Company LinkedIn Profile

What one notices first on the official LinkedIn company page (https://www.linkedin.com/company/unilever?trk=top_nav_home) is the photography of the smiling, cheerful people, employed in Unilever, who form harts with their hands. In this way, the company sends a clear message that it wants to position itself as a responsible and eligible employer, who treats its employees in a suitable manner. Very often does the company post things regarding the subject of sustainable business which can be shared and commented by the users, but it is also noticeable that the company doesn't answer the questions from the comments, which can be interpreted by the stakeholders as the company's lack of interest to dedicate itself to them or the wish to hide something.

4.2. Starbucks Company

Starbucks is a multinational company which deals in coffee retail and owns a chain of coffeehouses around the world, but it is also present on many other markets. According to the data available on the company website, there are more than 21,000 Starbucks coffeehouses in more than 64 countries around the world, which annually sell more than 2 billion cups of coffee ((http://www.starbucks.com). Starbucks is one of the global brands which was the first to accept, use, and recognise the strength of digital media and thus took over the leader position in that area for a while. For communication with the stakeholders, they use almost all of the available channels – website, corporate blog, but also social networks, such as Facebook, Twitter, YouTube, LinkedIn, Google +, Pinterest, and Instagram.

4.2.1. Starbucks Company Website

Unlike Unilever Company, which intensively communicates sustainable development related subjects through a number of website segments, Starbucks focuses on its page on the corporate social responsibility, and the link to it is in the horizontal navigation at the website home page (http://www.starbucks.com/) under the name "Responsibility". In addition to the company news, there are campaign news and CSR news.

A click on the "Responsibility" link in the horizontal menu leads to a special website page about the corporate social responsibility of the company. The page is structured in such a manner that an average user can quickly notice that the company's CSR focuses on three areas – environment, ethical sourcing, and community. A special segment is dedicated to promoting CSR reports. Each CSR area is an individual subpage which offers additional information on realised and current activities and campaigns. Navigation is

additionally facilitated since the users can move from one subpage of the website to another without previously going back to the homepage. The subpages are very simple, and, one could say, visually poor in comparison to the Unilever Company website, since in addition to the text they usually contain one video and a multitude of links.

The company doesn't offer a lot of ways of communication with the users on the subject of corporate social responsibility via the website. One of the possibilities is that the users send their ideas and suggestions to the special email address.

4.2.2. Starbucks Company Facebook and LinkedIn Profile

Starbucks Company Facebook page has just above 35,637,571 followers, and it releases the company news averagely two times per week. Unlike Unilever, Starbucks invests additional efforts to create natural conversation by answering almost every question or comment of the users, especially in they are negative.

According to the intensity of communicating realised and current campaigns on the subject of investments in the local community on the company website, it can be concluded that Starbucks invests the majority of the resources in this area of corporate social responsibility. A similar way of communication is used on the Facebook page.

Through the analysis of the posts and additional applications, one gets an impression that the company, via Facebook social network, mostly addresses the consumers and potential employees as the members of the community in which it does business, hence the desire to represent itself as a responsible and eligible employer is noticeable. For example, the specially emphasised sentence is that Starbucks provides equal opportunities for employment to all qualified persons including women, the elderly, and persons with disabilities, and the word "employees" is substituted by the word "partners" in all the news and videos.

The communication on LinkedIn social network (https://www.linkedin.com/company/starbucks) is similar to that on Facebook. The stakeholders can read and comment the news which is usually redirected from the company website. The covered topics usually have to do with employment or have a goal of promoting the company as a responsible and eligible employer. For example, the news released in June 2015 regarding the recognition for the leader in employing persons with disabilities in 2014, which was awarded by the American Association of People with Disabilities, after only four days had 352 likes and 17 comments, whereas a post regarding a company product has around 200 likes and 10 comments in average, which points to the interest of the stakeholders for social issues and the significance of communicating corporate social responsibility. There is also a special section called "Starbucks Careers" available for the users, with very similar content and functionality as the "Open Jobs" Facebook application. Starbucks LinkedIn page has more than half a million followers, among which there is a large number of the people already employed at this company.

4.2.3. Starbucks Company Twitter Account

Starbucks Company Twitter page (https://twitter.com/Starbucks) named "Starbucks Coffee" gathers around 8,500,000 followers. The company mostly posts things with the aim of promoting its products and brand. Although it looks like the company has left out this channel of communication from communicating corporate social responsibility, it hasn't always been like that. Starbucks realised a very successful campaign in 2013, named #comeTogether, inviting the American citizens to sign the petition which was started as a response to American Government Shutdown and human rights endangerment. After the campaign was over, the Starbucks Company gathered more than two million signatures which was a pretty good result, considering the subject of the campaign.

Communicating corporate social responsibility via social networks can have numerous advantages, such as improving the relationship with the stakeholders, and strengthening the reputation, but it can also have a completely opposite effect. Starbucks Company has started another campaign, and this time under the name #raceTogether with the aim of raising the awareness of the racial discrimination. On the day of the campaign start, 17th March 2015, the discussion on Starbucks Twitter account has risen for an incredible 266%, however, the 60% of the responses were characterised as negative. The next day, 18th March, the extent of the discussion has risen for 408%, compared to the trend in the previous months, but 62% of the posts were negative or very critical of the campaign (http://www.adweek.com/socialtimes/starbucks-race-together-campaign/617593). After the negative reaction of the stakeholders, Strabucks abandoned the campaign, but the damage had already been done.

4.2.4. Starbucks Company YouTube Channel

It is interesting that Starbucks doesn't own any additional YouTube channels except for the official company channel, which has over 77 thousand of signed in followers. Through the videos analysis, a conclusion is reached that the company uses video material for promotion of corporate social responsibility to some extent, but not with the intensity of Unilever Company. The most famous campaign in the CSR area on this social network that Starbucks Company conducted, was realised during 2013, under the name "Giving Back". Through a set of videos, the company wanted to present the way in which it contributed to the local community, i.e. the results of various socially responsible projects, but from the perspective of the project users. This is an excellent way of representing the results because videos are very emotional and the viewer can easily sympathise with the project users and the depicted problems.

4.2.5. Starbucks Company Blog

This communication channel enables the companies to connect to the stakeholders in a way which is more personalised, transparent, and interactive than the reports, press releases, and other formal communicational channels. The companies can tell their story about CSR in a more informal way and show they are open for discussion, new ideas, and suggestions. The blog which was started by Starbucks Company certainly had a great potential for such a thing. The blog is made up of 13 categories, one of the categories is dedicated to corporate social responsibility. The posts within categories contain video material, photographs, as well as the statements of the company CEO, who directly addresses the users on different subjects. The users can also access the archive of posts from 2009 to 2013. However, the last post on the corporate blog was published on 7th October 2013, so it could be said that the company missed the opportunity to use the great potential the corporate blog had as a channel of communicating corporate social responsibility to the stakeholders.

The result of content examination this company communicates through digital media channels shows that it is a very consistent way of communication, directed towards the consumers and potential employees with the aim of creating a perception that the company is a responsible employer who invests in the local community in which it does business and in the employees as the members of the local community in question. The company has an incredible reach on social networks (Facebook, Twitter, LinkedIn, YouTube), functional and attractive website, as well as a well set blog, but all of these channels are insufficiently used for communicating CSR strategy, aims, but also the results of the many CSR campaigns the company conducts.

5. CONCLUSION

In order for the right information to reach the stakeholders, the companies must take the integrated approach in communicating corporate social responsibility. It is an approach which includes using as largest number of digital communication channels as possible, from websites and blogs, to social networks, among which the most important are Facebook, Twitter, LinkedIn, and YouTube.

Successful and holistic communicational plan of corporate social responsibility should incorporate using as many channels as possible so as to deliver the message to various target publics. On the homepage of a corporate website there should be a clearly positioned link which would lead to a special page with more information about social responsibility of the company, because if the users cannot find this type of information, they will assume that the company doesn't engage in it at all. A page dedicated to corporate social responsibility has a positive influence on the stakeholders while collecting the information about the company business. CSR related content, whether it is on a special page or pervades a number of website elements, should contain value added, i.e. the pieces of information which cannot be found anywhere else, so as to attract the interest of the key stakeholders. Moreover, it is necessary to additionally encourage two-way communication, which is hard to realise through a website, but with the corresponding activations (which, for example, were implemented by Unilever Company – questionnaires, surveys, interactive maps) that, too, is possible to accomplish.

Social networks allow a high level of interaction with the stakeholders and provide opportunities for the company to promote its CSR strategy, goals, and results to the wide auditorium. In other words, social networks are ideal for storytelling, i.e. representing the company story about social responsibility. Thanks to a well told story about CSR, companies can raise interest and establish much better communication with the interest groups, than it would be the case with using dull facts and messages.

Through the corporate blog the company shows that it is open to discussion with the stakeholders on the subjects in the area of corporate social responsibility in a way which is more personal, transparent, and interactive than reports, press releases, and other more formal communicational channels.

And finally, an adequately presented CSR report is the best indicator of the company's dedication to corporate social responsibility, as well as transparent conducting of business and comprehensive communication. An online report which the company can communicate through all digital communication channels offers the stakeholders an experience and the content with added value. Through integration of interactive functionalities, turning statistical data into dynamic visual infographics and monotonous textual statements into video representations, and the browsing which is made easier by hyperlinks, the stakeholders are not only allowed to get the wanted information in a more simple and quick way, and absorb a larger amount of data from the reports, but also to share the newly acquired knowledge with their friends and business partners via various digital communication channels.

Via the internet, the stakeholders do not only download CSR reports and get the information about the corporate social responsibility strategy, but also comment, criticise, and express their opinion on socially responsible activities of a company on different channels. This can be beneficial for the company and its business development, but also a great risk at the same time. The company can easily loose control over the message it sends via digital media channels, as it was the case with Starbucks Company #raceTogether campaign, and significantly damage the reputation of the company. Managing the digital media channels is essential for avoiding the risks. That includes a good communication policy and a timely reaction to the critical content. Irregular maintenance, content which is not up to date, and not responding to the users' questions can cause negative users' reactions, and create an image of an irresponsible, disinterested company in the eyes of the stakeholders important for the company business, or a company which hides something from the curious citizens.

REFERENCES

Bagozzi R. P., Bergami M., Marzocchi G. L., & Morandin G. (2012). Customer-organizational relationships: development and test of a theory of extended identities, *Journal of Applied Psychology*, 97(1), 63-76.

Bonini, S., Koller, M.T., & Mirvis, P. (2009). Valuing Social Responsibility Programs. *McKinsey on Finance*, 32, 11-18

Carroll, A. B. (1999). Corporate social responsibility – evolution of a definitional construction. *Business and Society,* 38(3), 268–295.

Dahlsrud, A. (2008). How Corporate Social Responsibility is Defined: An Analysis of 37 Definitions. *Corporate Social Responsibility and Environmental Management,* 15(1), 1–13.

European Commission. (2003). *White Paper on Corporate Social Responsibility*, EC, Brussels

Georgescu, M., & Popescul, D. (2015). Social media – the new paradigm of collaboration and communication for business environment, *Procedia Economics and Finance*, 20, 277 – 282.

Khan, S., & VanWynsberghe, R. (2008). Cultivating the Under-Mined: Cross-Case Analysis as Knowledge Mobilizetion. *Forum Qualitative Sozialforchung*, 9 (1)

Kotler, F., & Lee, N. (2007). *Korporativna društvena odgovornost: učiniti najviše za svoju kompaniju i za izabrani društveni cilj: najbolje prakse videćih kompanija.* Ekonomski fakultet, Beograd, 93-171

Safko J., & Brake, D.K. (2009). *The Social Media Bible: Tactics, Tools, and Strategies for Business Success.* New Jersey: John Wiley & Sons.

Scoble, R., & Israel, S. (2006). *Naked conversations – how blogs are changing the way businesses talk with customers*, New Jersey: John Wiley & Sons In.

Sen, S., Bhattacharya, C. B, & Korschun, D. (2006). The Role of Corporate Social Responsibility in Strengthening Multiple Stakeholder Relationships: A Field Experiment. *Journal of the Academy of Marketing Science*, 34(2), 158-66

Tate, M.A. (2010). *Web wisdom – how to evaluate and create information quality on the Web*, Florida: Taylor & Francis Group

Vlastelica Bakić, T. (2012). *Upravljanje reputacijom primenom koncepta korporativne društvene odgovornosti u marketingu i odnosima s javnošću,* doktorska disertacija, Fakultet organizacionih nauka, Univerzitet u Beogradu, Beograd

Vlastelica Bakić, T., Cicvarić Kostić, S. & Nešković, E. (2015). Model for Managing Corporate Social Responsibility, *Management*, 74, 47-56

http://pr.org.rs/prijem-2015-dodeljena-priznanja-profesionalcima/

http://www.adweek.com/socialtimes/starbucks-race-together-campaign/617593

http://www.forbes.com/companies/starbucks/

http://www.google.com.au/think/case-studies/unilever-project-sunlight-video.html

http://www.lundquist.it/6th-csr-online-awards-white-paper?cat_slug=whats-on/white-papers

http://www.starbucks.com/

http://www.sustainability-indices.com/review/industry-group-leaders-2014.jsp
http://www.unilever.com/
https://twitter.com/Starbucks
https://twitter.com/unilever
https://www.facebook.com/Starbucks
https://www.facebook.com/unilever
https://www.linkedin.com/company/starbucks
https://www.linkedin.com/company/unilever?trk=top_nav_home
https://www.youtube.com/Starbucks
https://www.youtube.com/Starbucks
https://www.youtube.com/user/Unilever

MANAGING DIGITAL MARKETING COMMUNICATION IN ORGANIZATIONS IN SERBIA

Tamara Veselinović[1], Tamara Vlastelica*[2], Danijela Lalić[3]
[1]Victoria Group AD
[2]University of Belgrade Faculty of Organizational Sciences
[3]University of Novi Sad Faculty of Technical Sciences
*Corresponding author, e-mail: tamarav@fon.rs

Abstract: *The aim of this paper is to examine how digital marketing communication is managed in organizations in the Republic of Serbia. The empirical study employed questionnaire as a research tool on a randomly selected sample of 231 private and publicly owned organizations, and examined different aspects of digital communication management: strategic planning, monitoring, community management, content management, online advertising, search engine optimization, human resources and training. The findings indicate that the majority of organizations use digital communication within marketing communication mix and confirm efficiency and cost-effectiveness of its usage. The results showed that its activities are most frequently executed in-house, with a high percentage or organizations having one employee dedicated to these tasks. For further improvement in this field there is a need for more investment in education of employees.*

Keywords*: digital communication, marketing communication, online advertising, search engine optimization, community management, content production*

1. INTRODUCTION

The information and communication technology (ICT) development and expansion contributed to changes in all the areas of business, including marketing and public relations. The ICT helps the consumers connect and communicate with each other, and at the same time allows establishing a connection between a company/brand and the consumers (Kitchen & Burgmann, 2010; Hall-Phillips et al., 2016; Hudson et al., 2015).

Digital communication is an indispensable part of the integrated marketing communications, within which, through coordination of promotion and all the other marketing efforts, a maximum informational and persuasive effect on the consumers is achieved (Pride & Ferrel, 2014).

Digital communication tools enable two-way communication with the consumers and multimedia content transmission (Bauer, 2013). This communication can be initiated through different digital channels from any location at any time (Yadav et al., 2015). Digital communication tools also enable distribution of personalized content based on the consumers" needs (Chan & Yazdanifard, 2014).

Rapid development of digital technology has resulted in diverse platforms, among which Weintraub Austin & Pinkleton (2015) list services that enable customer relations management, search engine optimization, trackable analytics, social media engagement and networking, online advertising, digital direct mail, content-based applications etc. According to the same authors, the consequence is that marketing communications and public relations changed their „top-down" model to real-time conversations, stakeholders" engagement and establishing relationships.

Internet technologies, social media and mobile technologies have had a large impact on businesses (Dong & Wu, 2015). A website, as a basic instrument of web communication and presentation of an organization on the Internet, enables informing, promotion, sales and customer support (Tate, 2010). Blogs are efficient in managing the online reputation (Cho & Huh, 2007). With the growing popularity of social media, companies are actively engaging consumers through social media sites (Bagozzi et al., 2012).

Considering increasing level of usage and important role of digital communication in different business processes and potential benefits which their adequate usage bring to the organizations, there is a need for exploring different segments that digital communication management encompasses (Vlastelica Bakic, 2012). The goal of the research presented in this paper is to provide a systematic insight into the current state of the

digital communication in Serbia and with the aim of acquiring scientific and practical knowledge and its application in real systems.

2. DIGITAL MARKETING COMMUNICATION MANAGEMENT

An especially significant change in communication practice was brought about by social media through enabling the highest level of interaction between communication participants (Tiago & Verissimo, 2014). According to Sidjanin (2012), social media management encompasses marketing campaigns coordination, creating content that is of interest for the consumers and prompts them to further sharing, managing customer relations and sales on these digital communication channels. The same author also states that social media managing includes the following activities: managing social networks profiles, presentation, offers, advertisements and branding, creating content and responding to the received messages, preparing social media guidelines, reporting and analytics.

In the past few years, content marketing strategy became an integral part of digital communication management. Content marketing is the process in which relevant and valuable content is produced and distributed to attract, acquire, and engage a clearly defined target audience with the objective of driving profitable customer action (Pulizzi, 2012).

In a research conducted by Content Marketing Institute and Marketing Profs about the usage of B2C content marketing in North America, 76% of the marketers said that they used content marketing in their organizations. Among the possible tactics at the disposal of the marketers, this research quotes the following digital tools: social media content, blogs, website articles, microsites, online presentations, webinars/webcasts, e-newsletters, illustrations and photos, videos, infographics, branded content tools and mobile applications.

Nevertheless, compared to global trends organizations in Serbia are behind in digital communication usage. The results of a recent research (Veselinovic, 2015) indicate that a majority of organizations do not use blogs, Twitter, photo sharing SNSs, YouTube, LinkedIn and do not have online sales. Dominant digital tools are website and Facebook; whilst dominant activity is online advertising. The percentage of organizations that do not practice e-mail and mobile marketing is very similar to the percentage of those that actively use it.

However, in Serbia, according to annual statistics of the Statistical Office of the Republic of Serbia regarding the usage of information and communication technology between 2011 and 2014, the usage of digital media rises each year, and the number of Internet users, as well as the extent of its usage continually rises. Realizing that the Internet users represent a valuable target market, organizations in Serbia dedicate more and more attention to digital communication, but for further progress in this field, managers‟ education is necessary.

The growing significance of digital communication for organizations in Serbia is also expressed through the data of continual growth of digital advertising market. The research about digital and interactive advertising in Serbia AdEx2014, which was conducted by IAB Serbia (Interactive Advertising Bureau Serbia), concluded that the digital advertising market in 2014, compared to 2013, rose by 11.82%, reaching the overall value of over 18 million Euros, and the further growth of this market has been predicted. The largest share in 2014, as well as in the previous years, had display advertising (47.14%), but mobile advertising realized the largest growth the second year in a row (108%). A significant growth was recorded in social media advertising as well (21.15%). This data indicate that digital communication managers are slowly including newer, innovative formats of online advertising.

3. RESEARCH METHODOLOGY

The aim of this paper is to examine how digital marketing communication is managed in organizations in the Republic of Serbia. The research presented in this paper is a part of a larger study conducted for the purpose of the doctoral dissertation (Veselinovic, 2015). The empirical study was based on primary data and employed questionnaire as a research tool, using both paper-and-pencil and computer assisted approaches.

The questionnaire was distributed in the period July-December 2014 on a randomly selected sample of 231 private and publicly owned organizations (companies, institutions and banks) in Serbia. Companies were chosen from the “Biznis Top”, the rankings of the most successful Serbian companies, according to the turnover and profit, published by magazine “Biznis & Finansije”. Banks were chosen from the “Finansije Top”, the rankings of the most successful banks, insurance companies, brokerage companies, private investment

and pension funds and auditing companies, based on official financial analyses and analyses of each sector, published by magazine "Biznis & Finansije" as well. Institutions were selected from the administrative register on the website of the Statistical Office of the Republic of Serbia.

The study was focused on managers of different managerial levels. The precondition was that they were familiar with the digital communication in their organization. The aims and purposes of the study were firstly explained to all examinees that participated in the study and their involvement was on a voluntary basis.

The examined organizations were stratified based on the 4 features: size, industry, business maturity and geographical coverage. The examined organizations sample structure is presented in Table 1.

Table1. Sample structure

Organization features	Absolute frequency	Relative frequency
Size		
Micro-organizations (less than 10 employees)	44	19.0
Small organizations (11-50 employees)	47	20.3
Medium sizes organizations (51-251 employees)	54	23.4
Large organizations (more than 251 employees)	86	37.2
Industry		
Manufacturing	51	22.1
Services	150	64.9
Manufacturing and services	30	13.0
Business maturity		
Up to 5 year	41	17.7
From 6 to 15 years	93	40.3
From 16 to 25 years	23	10.0
From 26 to 35 years	24	10.4
More than 35 years	50	21.6
Geographical coverage		
Local level	60	26.0
National level	37	16.0
Regional level	37	16.0
Multinational level	97	42.0

The questionnaire examined different aspects of digital communication management in organizations. The scale and purpose of research were firstly explained to the respondents. Respondents were asked to rate the following statements on a five-point Likert-type scale, where „1" stands for „strongly disagree" and „5" stands for „strongly agree":

- Digital communication is being used in marketing communication mix of my organization
- My organization strategically plans digital communication activities
- My organization monitors digital communication activities
- My organization practices online advertising
- My organization practices search engine optimization
- My organization organizes trainings and education on digital communication tools
- The usage of digital communication tools and activities made my organization"s overall communication more efficient and cost-effective.

Additionally, the respondents were asked about internal organization, responsibilities and processes of digital communication management. This part of the questionnaire included 3 multiple-choice questions:

- My organization employs at least one person responsible for digital communication management
- My organization manages digital communication (publishing and community management) in-house, without outsourcing to agencies
- My organization produces digital communication content (text, graphics, audio, video etc.) in-house, without outsourcing to agencies

4. RESULTS

Descriptive statistics results on the digital communication management in organizations in the Republic of Serbia are shown in Tables 2 and 3.

Table 2. Digital communication management in organizations in Serbia - activities and characteristics (absolute and relative frequencies)

Statements	Frequencies	1	2	3	4	5
Digital communication used in marketing communication mix	Absolute	27	19	28	29	128
	Relative	11.7	8.2	12.1	12.6	55.4
Strategic planning of digital communication	Absolute	29	18	42	43	99
	Relative	12.6	7.8	18.2	18.6	42.9
Monitoring of digital communication activities	Absolute	36	5	36	43	111
	Relative	15.6	2.2	15.6	18.6	48.1
Online advertising in digital communication activities	Absolute	27	15	30	63	96
	Relative	11.7	6.5	13.0	27.3	41.5
Search engine optimization in digital communication activities	Absolute	61	52	30	26	62
	Relative	26.4	22.5	13.0	11.3	26.8
Trainings for employees on digital communication tools	Absolute	42	33	50	41	65
	Relative	18.2	14.3	21.6	17.7	28.1
Digital communication efficiency and cost-effectiveness	Absolute	21	4	60	47	99
	Relative	9.1	1.7	26.0	20.3	42.9

Table 3. Internal organization of digital communication management in organizations in Serbia (absolute and relative frequencies)

Statements	Frequencies	Answers		
Employee responsible for digital communication management		None	Combined*	DC** manager
	Absolute	37	68	126
	Relative	16	29.5	54.5
Online publishing and community management		Outsourced	Combined	In-house
	Absolute	42	34	155
	Relative	18.2	14.7	67.1
Content production for digital communication channels		Outsourced	Combined	In-house
	Absolute	59	31	141
	Relative	25.5	13.4	61

*Employee has other responsibilities besides digital communication management
**Digital communication

The results of the empirical study in Serbia indicate that more than half of organizations use digital communication in the marketing communication mix. With this claim strongly agree 55.4% of questioned organizations, which together with 12.6% that agree makes up 68%. Only 11.7% of the organizations do not use digital communication at all.

Strategic planning and monitoring of digital communication are processes which recorded similar results, and more than half of the organizations include them as obligatory in digital communication management (42.9%, i.e. 48.1%, for „strongly agree"). Online advertising is very present in organizations in Serbia – 68.8% practice it (41.5% - mark „5" and 27.3% - mark „4").

The situation is significantly worse when it comes to search engine optimization, an activity practiced by 38.1% of the organizations (marks „4" and „5"). Marks for the practice of search engine optimization activities are most equally distributed on the Likert scale. The education in the field of digital communication is at a low level. The highest attention to education dedicates only 28.1% of the organizations, and for another 17.7% this is an important subject.

Only 10.8% of the questioned organizations marked efficiency and cost-effectiveness of digital communication with the lowest marks („1" and „2"). Although there is 26% of those neutral on this question, very positive data is that as much as 63.2% (marks „4" and „5") confirm benefits of the digital tools and activities usage.

When it comes to the internal organization of digital communication management, more than half of organizations (54.5%) have at least one employee who is dedicated exclusively to the digital communication

activities, whereas in 29.5% of organizations, the employee in charge of digital communications does other work as well.

For complementary processes of online publishing and community management on one side, and content production on the other, the results are similar. In both cases, the majority of organizations manage these processes in-house (67.1%, i.e. 61%), whereas 18.2%, i.e. 25.5% always outsource them. The least number of organizations use combined model where a part of the activities is outsourced, and a part is done in-house (14.7% for administration, 13.4% for content production).

5. DISCUSSION AND CONCLUSION

The growing usage of digital communication tools worldwide and numerous case studies published by organizations that have successfully implemented them and documented the increase in reputation and/or sales results due to their usage, indicate various possible benefits for business.

The research presented in this paper had the goal to identify the level of digital communication usage in overall communication mix in organizations in Serbia, to explore different aspects of digital communication management (strategic planning, monitoring, community management, content management, online advertising, search engine optimization, human resources and training), but also to determine if the usage of digital communication gives positive results in terms of efficiency and cost-effectiveness of communication.

The important findings are that the majority of organizations, significantly more than half, use digital communication together with online advertising, as well as that in the similar percentage of the questioned organizations, the usage of digital communication brought to more efficient and cost-effective communication. This data indicates a significant penetration of digital communication in the business use in Serbia and understanding of their benefits. With the new tools that allow micro targeting, a very precise result measuring, and detailed performance analysis, we can expect further growth in this segment.

The sample analyzed in this research has also shown other positive tendencies in the form of high percentage of the organizations that strategically plan their digital communication activities and monitor them. Strategic approach to digital marketing is very important, since it is the only way to track its performance and to check if the set goals, both communication and business, have been achieved. In that way, efficiency and cost-effectiveness of digital communication can be demonstrated, which would again make possible an increase of the marketing budget meant for these activities.

Encouraging as well is the high percentage of the organizations which have at least one person in charge of digital communication, which suggests that top management recognizes its significance. Also, it is in accordance with the findings that digital communication is most frequently done in-house, both for administration and content production for digital channels. That can be explained by the fact that large organizations have internal human resources at their disposal, whereas the cost of hiring an agency is often a problem for small organizations. We can expect that in the period to come, digital marketing agencies engagement will increase together with the market development, an enlarged scope of digital communication activities and their complexity, following the global trends, and implementing new tools. Together with showing the efficiency and cost-effectiveness of digital communication in the practice of organizations in Serbia, it can be expected that the number of organizations which have an employee on the position of digital manager will also increase.

According to the research there is a clear need for improvement when it comes to search engine optimization activities and providing education in digital communication tools usage and application for employees. These results show that, in practice, it is necessary to focus on these neglected segments.

It is especially important to coordinate marketing efforts in digital environment with offline marketing activities. Only through their integration organization can obtain a synergetic effect of the marketing messages and strengthen the influence on the consumer who, in all communicational points in which he meets the brand/organization, gets unique, consistent, and stimulating user experience. In order for marketers to get this result in practice, it is necessary to significantly raise the level of education, as well as the awareness that in a fast-moving area, such as digital marketing, it is necessary to continually improve knowledge and acquire new skills demanded by frequent innovations of digital tools.

REFERENCES

Bagozzi R. P., Bergami M., Marzocchi G. L., & Morandin G. (2012). Customer-organizational relationships: development and test of a theory of extended identities. *Journal of Applied Psychology*, 97(1), 63-76.

Bauer, I. (2013). *Digitalni marketing*. Zavod za udžbenike, Beograd.

Chan, J. M., & Yazdanifard, R. (2014). How social media marketing can influence the profitability of an online company from a consumer point of view. *Journal of Research in Marketing*, 2(2), 157-160.

Cho, S.,& Huh, J. (2007). Corporate blogs as a public relations tool: a content analysis applying the relational maintenance framework. Paper presented at the *Annual Conference of International Communication Association*, San Francisco.

Content Marketing Institute & Marketing Profs (2015). *B2C content marketing. 2016 Benchmarks, budgets and trends – North America*. Retrieved from http://contentmarketinginstitute.com/wp-content/uploads/2015/10/2016_B2C_Research_Final.pdf

Dong, J. Q., & Wu, W. (2015). Business value of social media technologies: Evidence from online user innovation communities. *The Journal of Strategic Information Systems*, 24(2), 113-127.

Hall-Phillips, A., Park, J., Chung, T. L., Anaza, N. A., & Rathod, S. R. (2016). I (heart) social ventures: Identification and social media engagement. *Journal of Business Research*, 69(2), 484-491.

Hudson, S., Huang, L., Roth, M. S. & Madden, T. J. (2015). The influence of social media interactions on consumer–brand relationships: A three-country study of brand perceptions and marketing behaviors. *International Journal of Research in Marketing*, 33(1), 27-41.

IAB Serbia (2015). *Adex 2014 - Studija o potrošnji na digitalno i interaktivno oglašavanje u Srbiji za 2014. godinu.* Retrieved from http://iab.rs/wp-content/uploads/2015/05/AdEx-2014_IAB-Serbia_MAJ2015.pdf.

Kitchen, P. J. & Burgmann, I. (2010). Integrated Marketing Communication. *Wiley International Encyclopedia of Marketing*, 4. Retrieved from http://onlinelibrary.wiley.com/doi/10.1002/9781444316568.wiem04001/full.

Pride, W. & Ferrel, O. (2014). *Marketing*. South-Western Cengage Learning, Mason.

Pulizzi, J. (2012). *Six useful content marketing definitions.* Retrieved from http://contentmarketinginstitute.com/2012/06/content-marketing-definition/

Republički zavod za statistiku (2015). *Upotreba informaciono-komunikacionih tehnologija*. Retrieved from http://webrzs.stat.gov.rs/WebSite/Public/PageView.aspx?pKey=206.

Šiđanin, I. (2012). Menadžment socijalnih medija i medijsko okruženje. *Škola biznisa*, 4, 17-23.

Tate, M.A. (2010). *Web wisdom – how to evaluate and create information quality on the Web*. Taylor & Francis Group.

Tiago, M.T.P.M.B. & Verissimo, J.M.C. (2014). Digital marketing and social media: Why bother? *Business Horizons*, 57(6), 703-708.

Veselinović, T. (2015). *Koncept digitalnih komunikacija u okviru integrisanih marketinških aktivnosti poslovnih sistema, doktorska disertacija*. Fakultet za primenjeni menadžment, ekonomiju i finansije, Beograd.

Vlastelica Bakić, T. (2012). *Upravljanje reputacijom primenom koncepta korporativne društvene odgovornosti u marketingu i odnosima s javnošću, doktorska disertacija*. Fakultet organizacionih nauka, Beograd.

Weintraub Austin, E. & Pinkleton E., B. (2015). *Strategic Public Relations Management: Planning and managing effective communication campaings*. Routlegde, New York.

Yadav, M., Joshib, Y. & Rahmanc, Z. (2015). Mobile social media: The new hybrid element of digital marketing communications. *Procedia - Social and Behavioral Sciences*, 189, 335-343.

SOCIAL MEDIA AND PUBLIC SECTOR - THE EXPERIENCE OF THE USE OF SOCIAL MEDIA IN STATE ORGANIZATIONS AND SERBIAN DEFENSE STRUCTURE

Đurić-Atanasievski Ksenija[1], Bobar Zoran[2]
[1] Department of Management, Military Academy, University of Defense , ksenija.djuric@mod.gov.rs
[2] Public Relations Department, Ministry of Defense of the Republic of Serbia, zoran.bobar@mod.gov.rs

***Abstract**: Social media have changed the way of communication in 21st century and made specific interactions among users possible. The participation of the public sector in social media may improve the communication with citizens and improve the relation government-citizens. The use of social media is of particular importance to the defense structure.*
This paper presents specific ways the social media is used by the public sector. It outlines the aims and communication procedures that military organizations utilize in global social networks and the use of social media by the Ministry of Defense and the Serbian Armed Forces in relation to the other government bodies in Serbia. The paper also analyzed the content and efficiency of the announcements of Ministry of Defense and the Serbian Armed Forces according to their types and content in 2015.

***Key words**: social media, social network, public sector, defense structure, use of social media in defense structure*

1. INTRODUCTION

The public sector around the world has started using internet sites for its public relations more than thirty years ago. The world wide web has offered the public easier access to information, while sequentially, an informed public contributes to greater citizens' participation. It has also improved lobbying for the interest of the majority of social groups which led to better functioning of democratic processes. This was enabled by internet communication which limits the censorship, regulation and commercialization, like no other medium before. (McNair, 2005)

Information technologies and internet communication have facilitated formation of electronic government (eGov). E-government can be defined as 'the use by government agencies of information technologies that have the ability to transform relations with citizens, businesses, and other arms of government. These technologies can serve a variety of different ends: better delivery of government services to citizens, improved interactions with business industry, citizen empowerment through access to information, or more efficient government management' (World Bank, 2011). However, major activities of electronic government aim to educate and inform the public with possibility for some feedback mechanisms.

Only with the application of Web 2.0 and the creation of numerous collaborative and social media platforms, was it possible for the public sector to create genuine interaction. Social media encourage citizens to take part in decision making and enable government agencies to create two-way communication. Gov2 was created once new technologies were integrated together with a change in organizational culture, to increase openness, participation, transparency and collaboration in the public sector (Mergel, 2012) Although the term of Gov2 has often been used as a synonym for open government, there is a difference. Open goverment stresses on data openness and citizen engagemnet and the OECD (2009) defines it as a 'transparent, asccessible and responsive governance system, where information moves freely both to and from govermnet, through a multitude of channels'.

The capabilities of social media are evident in the way they support development of the public sphere and civil society. To support the democratic process, it is of crucial importance that political institutions become more transparent and accessible to the public which can follow, support or lodge complaint on institutions' functions and work.

The democratic potential of virtual communication is reflected in the fact that it overcomes the traditional status of unequal participants. For organizations that want to improve their democratic character, it is important to enable any citizen to directly and easily contact any elected political representative. (Đurić-Atanasievski, 2013). Today, the majority government initiatives focus mostly on participation and transparency and less on collaboration (Karakiza, 2015)

Institutions and organizations in the public sector can have different communication objectives related to social media, but their basic purposes are:

1) To increase transparency;
2) To support interagency and internal collaboration; and
3) To enable innovative forms of participation and engagement.

The increased level of transparency of public administration also creates higher accountability of government organizations.(Bonson et al. 2012) For this reason, many communication experts regard social media to be a powerful tool which improves the relationship between a government and the public and can result in increased public trust and satisfaction with the work of government organizations. In addition, use of social media improves communication between government institutions and agencies, or internal communication within a single organization. Using social media, the public sector can initiate discussions on an important social topic, ask for community input, prevent incorrect information from being disseminated or to estimate general public opinion on certain issues. Creating a message and content that can be shared with the wide public network creates an opportunity to build an on-line community that has the same or similar interest in regards to certain issues.

In this context, social networks are especially important. Personal communication with a high number of contacts and topics that are sent through the web increases the number of users that can be informed or are willing to participate. Although the users do not need to submit their personal details to the government agency, they can sign up or 'like' the pages with government publications. This is useful to government bodies as the information they publish on social web becomes available to huge number of people.

The use of social media in the public sector also has other advantages compared to other ways of public relations and communication. Mergel (2013) has noticed that operating outside their protected public relations and public affairs context gives the public sector more freedom to choose platforms where they see the most of their audience members congregate. Besides, the use of social media by government bodies requires less of a traditional decision hierarchy, as this use has the perception of less formal modern technology. Furthermore, the use of social media does not necessitate purchase of special equipment for its implementation as all tools and applications are easily available.

Practical use of social media in the public sector is aligned with existing theories on public administration, e-government and management communication. However, good implementation strategy is necessary to realize benefits and to avoid risks. (Picazo-Vela S et al, 2012). The implementation of social media highlights the importance of updating laws and regulations, and of promoting changes in government culture and organizational practices. Nevertheless, it is evident that very often government organizations have not adopted communication strategies for social media. Also, the public sector needs organizational change, developing a culture of trust and openness that will allow public servants to take advantage of the benefits that social media offer. (Fyfe, Crookall, 2010). The use of social media requires proper staff training based on plans and guidelines for efficient promotion. If staff in the public sector has not been properly trained for interactive communication, increased public participation can produce unwanted tension between the organizations and targeted groups. This can lead to undesirable and unexpected outcomes.

2. USE OF SOCIAL MEDIA AND SOCIAL NETWORKS IN THE DEFENCE STRUCTURE

Ministries of defense and armies around the world increasingly use social media. The decentralized platform and networking of people through social media enable more informed public support in the area of defense. The aim is to give voice to the citizens that will make them a part of a community formed on common values and interest.

Social media substantially changes the way information is transferred and thus changes conditions of military operations. This is the reason why many armies develop strategies to consider the influence of social media as one of the keys to success of future operations.

Because Facebook, Twitter, Instagram, LinkedIn and other social networks are ever-present in our lives, the potential for their use by the military is nearly limitless. Furthermore, communication systems in the defense structure that use social media can be successful and credible only if it is based on well established, professional manners that are inherent to the defense structure.

Perhaps the biggest benefit for the military in using social media is to be aware of national or international public opinion. Social media can contribute to better understanding of the environment and help create more accurate images of the factors that influence civilians. For example, sentiment analysis is used to establish what is the prevailing feeling towards a certain topic amongst users. The military can implement this analysis in the case of preparing for implementation of a reform, deploying in a peacekeeping mission abroad, recruiting new members and for any other operation when it is useful to know what are public sentiments towards certain issues. The degree of success of a psychological and intelligence operation is defined, above all, by an overall sentiment of public interest in it. Insight into public opinion, gathered through social media, is broader and more authentic than the information collected by other methods of gauging public opinion. However, the downside is that anonymous opinion expressed in social media does not always reflect community standards. So, it is possible that some of the opinions are antisocial, anarchical, morally dubious and essentially, do not represent prevailing public opinion.

In the case of military forces, some specific ways of social media use make them being identified as the newest international battle field. An increasing number of armies in the world use social media for announcing operations in their zone of responsibilities or their propaganda campaigns. Maintaining a social media presence in deployed locations allows commanders to understand potential threats and emerging trends within their AOR – zone of operation (Mayfield, 2011). Using social media supports their fight for 'hearts and minds' in multinational operations or make them win a 'media war' by being seen as proactive and able to tell their truth in a battle against negative and false reports.

Social media has been used as a psychological weapon against enemies in the always growing domain of cyber space. This is one of the reasons behind Facebook supporting multiple languages. Social media are forums where victories are declared, public perception of the conflict is formed and public opinion, own or foreign, can be influenced. Military experts also follow any criticism of a conflict that users of social media express, whether they are domestic or from the enemy side. The British military has admitted that in 2015 they formed a special unit consisting of reservists and soldiers with journalist skills who are familiar with social media. The new unit, based in Berkshire is called the 77th brigade and employ a new tactic – psychological operations using social media. One of the armies that pioneered the use of social media in unconventional warfare in the information age is the Israeli Defense Force. Since 2008, Israeli Defense Forces have been active on 30 social media platforms including Facebook, Twitter, Instagram and YouTube in 6 different languages. Some defense forces, especially of the most powerful countries, have been trying to directly influence and channel conversation in social media. These armies employ methods such as setting up of false individual profiles and others in their psychological operations around the world.

Social media creates opportunities for intelligence functions as well. Infiltration into open and closed social networks provide important intelligence to counteract 'enemies' and their propaganda, or can be used effectively to locate a person of interest. Military intelligence instigates research and development of various software applications and currently the USA is a world leader in this type of software.

Last, but not least, social media is useful in establishing partnership and unity with collaborative organizations, such as other institutions or foreign armies employed in the same operations.

3. PUBLIC GOVERNANCE IN SOCIAL MEDIA IN THE REPUBLIC OF SERBIA

The UN E-Government Survey (2012) has indicated that Serbia has created a positive environment for the development of e-services which can further contribute to increased transparency in the public sector and more efficent democratic processes. The Survey finding is that 'particularly notable is Serbia's performance, which advanced 30 positions to arrive at 51st in the world rankings. In Serbia, the Digital Agenda Authority is responsible for introducing online services to improve economic efficiency and citizens' quality of life, and for implementing e-government in accordance with a "one-stop-shop" principle'.

In order to encourage and increase the use of internet and social media in the public sector, making it the official government channel of communication with its citizens, Directorate for Digital Agenda of the Ministry of State Administration and Local Self-Government prepared the following documents:

- *Guidelines on web presentations of government services, agencies of territorial autonomy and local self-governing units; and*
- *Guidelines on the use of social network in State and autonomus regions public agencies and local self-governing units.*

The performance of eServices web sites is measured against the critera set out in the Guideline. There are specific requirements that assess web pesentations of public authorities at State and local self-governing level. A yearly assessment report is submitted to the Government of the Republic of Serbia. Key criteria for assessmant is how relevant published material is in informing the public on the functions and work of public bodies and institutions. According to the Directorate's assessment for 2014, the average success of this criteria was 56.6%, while the real results were at the level of 54%. (Report, May 2015)

Analysis of online communications with the public on the eServices portal in 2015 provides some insight on how the advantages of a global network and social media are used to secure a visible public presence of governing bodies in the Republic of Serbia. The analysis also estimates what would be the future characteristics of the online relationship between the Government and the public. The results of the analyses have shown that the web presence of all levels of State bodies that provide basic information to the citizens is 83%; relationship with media through various forms of newsrooms is around 40%; while the presence on social media is lower, such as Facebook (19%) and Twitter (15%). However, the analysis of the level of interaction between the public e-Service and targeted groups are low. (See Table 1 below)

Table 1: State Government on internet in the Republic of Serbia

Level of governance	**Public management**	**Sample**	**Presence**	**Newsrooms or Pressrooms**	**Social rooms or links to the Social Media**		**FAQ**
					FB	TW	
State Government	Ministries	17	17	11	5	3	9
	Agencies	10	7	4	1	2	2
Regions and Districts	Regions	1	1	1	1	1	0
	Districts	10	5	1	0	0	1
Local self-governance	Local government	10	10	2	2	1	6

Publication of Frequently Asked Questions (FAQ) is a mandatory requirement in '*Guidelines on web presentations of government services, agencies of territorial autonomy and local self-governing units*'. However, the analysis of all relevant web sites confirmed that only 38% of public sector bodies have published their FAQ. The majority of published FAQs are at the first level of sophistication (72%) according to the criteria developed by company called Capgemini (2007). This assessment tool of the company is adopted as the official criteria for benchmarking the sophistication of public sector electronic services in the European Union (EU).

The analysis of the Serbian Government online services has also shown that there is no clarity on who administers social media, while finding online pages to enable communication with public service is unreliable and uncertain.

The analyses have revealed that compliance with the critera for quality online relationships between the public sector and citizens is differnete. (Table 2)

Table 2: Compliance with hte criteria

Criterion	Public managment bodies which met the criteria (in percentages)
Two way communication with citizens	98%
Dissemination of information via DM	64%
News on latest initative and events	79%
Contact email provided	96%

Two way communication is enabled mostly using emails. Profiles and pages on social media are used for dissemention of news and multimedia content. In other words, online relationship with public are mostly at the level of publishing information on activities of government agencies.

4. SOCIAL NETWORK USE IN THE MINISTRY OF DEFENSE AND SERBIAN ARMED FORCES

The Ministry of Defense and Serbian Armed Forces (MoD & SAF) has had an online presence since 1997. The Army web site was launched to the public on 15 December 1997. That is also the day of the first independent appearance of the Army on the internet, on its own official domain. The Army web site has become a part of the comprehensive display of affirmative information on the armed forces in public. The structure of the web site reflects the intention to incorporate both dissemination of information and the need for presentation (Bobar, 2009).

A sharp increase in the number of users, especially younger generations, was evident during 2008 when the Ministry of Defense opened their pages on YouTube (2 September 2008), Facebook (22 December 2009) and Twitter (1 June 2011). The aim was to enable direct, two way communication with young people, who are an extremely important demographic group for the MoD & SAF. (Đurić-Atanasievski, Bobar, Krivokapić, 2012)

The main MoD & SAF's objectives for the use of the global network and of social media have been to ensure public support for the activites of the defense system; to reach out to young generations and increase their interest in the military profession and possible recruitment into the professional armed forces and to enable communication in crises situations. An important objective was also to prevent false representation of the MOD & SAF in social media, that is, directing users of the network to offical sources of information. These objectives and methods are of lesser scope and not that sophisticated compared to the internet activities and social media engagement of other military forces.

Strategic presentation of MoD & SAF in social media depends on changes initiated by Defense Strategy and available resources in the defense structure.

The anaylsis of the Directorate for Digital Agenda that focused on the use of social media in State bodies and institutions, concluded that the Ministry of Defense is the most successful in all aspects: frequency of announcments, interactions with their audience and the extent of their reach. In the '*Guidelines on the use of social network in State and autonomus regions public agencies and local self-governing units'* the profile and web pages of the Ministry of Defense are listed as an example of good practice.

The analyses of the MoD & SAF' presentation in social media in 2015 has come up with the following statistics:

Ministry of Defense published 2205 news and announcement, sorted and adjusted to available profiles and pages on social media.

Facebook page of the MoD & SAF got 182.000 approvals ('likes'). On the Facebook page of DM & SAF visitors publi(sh on average more than 5.000 likes, 150 comments and 120 'shares' per day. Announcment on the participation of the Serbian Guard at the military parade in Moscow is a textbook example of the viral trend on social network. This announcment was viewed by 800.000 Facebook users.

Twitter profile of the MoD & SAF has accumulated 4.050 followers and published 2.830 short messages. Each messsage published on Twitter was resent multiple times, for example, information on a Tank biathlone in the Russian Federation or preparation for the military parade in China. The reach of short messages is much larger than what the available statistics can record and impact on journalists and experts is bigger than the standard exchange of information.

YouTube profile of the MoD & SAF has more than 25.000 views and more than 34.000 minutes of video material is viewed per month. The most popular clips are the opening ceremony of Tank biathlon in Russia, finals of the armoured vehicles competition, new recruitment video, *Be a professional,* offering jobs with the Army, video about shooting the film *Cizmas*i (Footsoldiers) and a report on the Guard preparation for the parade in Moscow.

Profiles on social network such as Facebook, Twitter and YouTube have been recognised by the public as an official and reliable source of information. That is of crucial importantce as the public sector often has to deal with the problem of reliability and authenticity of the source in social media, that is, to confirm if the source is official or fake.

4.1. Content analyses of MoD & SAF presentation on social media

The analyses of the profiles and pages of armed forces of EU countries indicate that the common theme is that of solders. Solders have the central role and the content published on social media reflects that (NATO Public Affairs Handbook, 2010)

Using available statistical tools on the profiles and pages of the social media of the Ministry of Defence, we have analysed the efficency of material published in 2015, according to the type and their content. Content analyses has been undertaken following two criteria: reach of the targeted public and engagement. Collected data was interpolated taking into consideration relative nexus according to the type of content. The results are presented in Table 2 and 3 below.

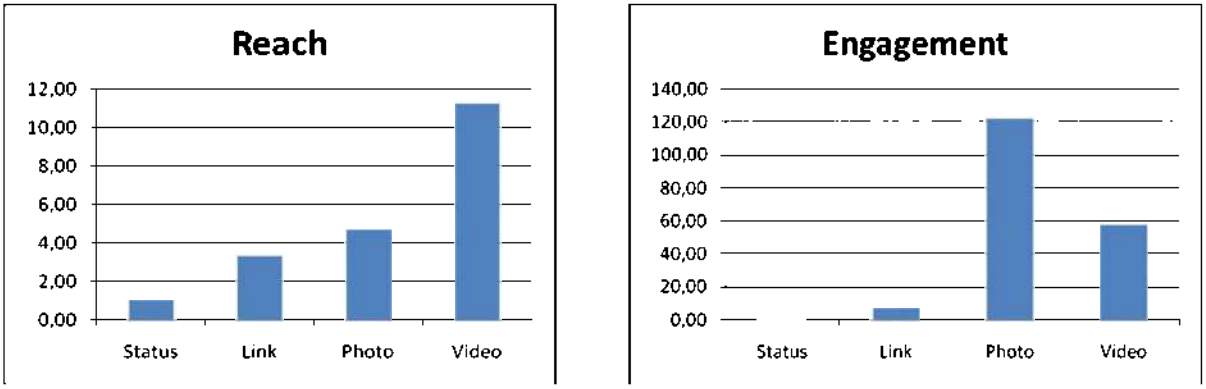


Figure 1&2: Interrelation of the announcement and its type to the reach and engagement of MoD & SAF social media

The finding of this analyses is that the most visited pages on MoD & SAF's social media are with video content, but photos initiated much higer engagement of the visitors to these pages compared to other types of content.

In order to still provide an answer to what content is the most suitable for publication on various social media, we have analysed the content on profiles and pages of MoD & SAF published during 2015. All content was put into following categories: training, practice, peacekeeping operations, natural disasters, promotions and defense politics.

Following the minimal and maximal values for each of the categories in 2015, we have defined relative relations, based on categories, for the maximal reach and engagement of each announcement. See table 4 below:

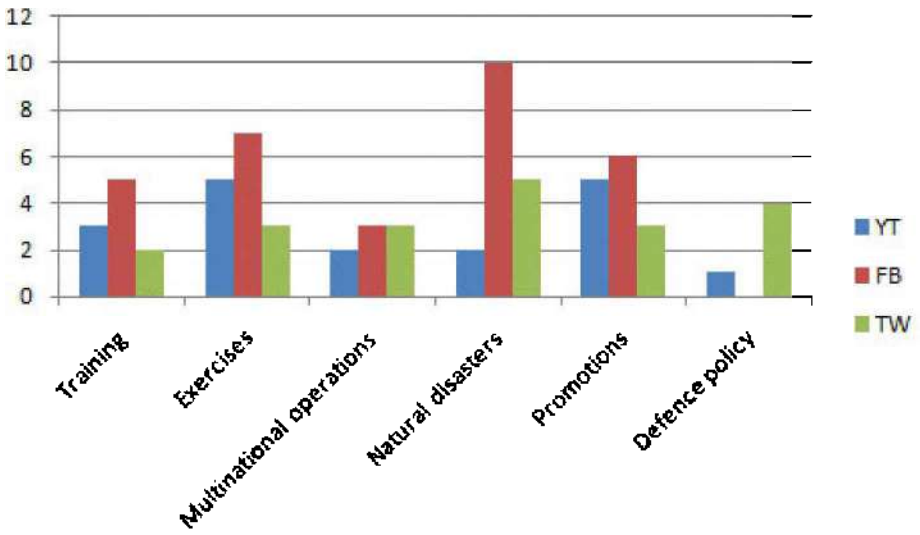


Figure 3: Categories of announcement on various social media and their relative relation

Results of these analyses confirmed that engagement of users point towards certain trends for each type of media. YouTube users most often follows clips which have content that is focused on training, practice, promotions. This is content where a soldier is a central figure.

Facebook pages initiated the most reaction when the army was involved in assisting crises during natural disasters or on their military drills. This type of content usually attracts a lot of positive comments and emotions.

The MOD & SFA Twitter profile initiates fairly equal reactions. It has also presented well as a medium useful for the distribution of information that have defense doctrine content.

5. CONCLUSION

Relevant research indicates that the public sector has not yet used all capabilities provided by social networks for the improvement of inclusive or consultative role of citizens anywhere in the world. In addition, the real effects of communication with the citizens has not been defined yet. However, existing survey of public workers, reveals that the participation of the authorities in social media may improve the communication and participation of the citizens, create greater transparency and transfer of the best practice between government agencies.

On the basis of previous experience in the implementation of social media as channels of communication of the Ministry of Defense and the Serbian Armed Forces, it can be concluded that the contents which are published on social networks are being followed by different social groups. The results of the 2015 analysis in the MoD and the SAF confirm that the editorial policy of the profile and the pages on the social networks must be well planned and based on evaluation of the publications in the previous period. This is especially related to the type of content and the content itself, i.e. suitability of the content for the specific type of social network. The analysis of the content of the MoD and the SAF confirm that the Youtube channel is a media suitable for promotional appearances, Facebook for communication with youths, and Tweeter for informing the public about the defense politics. Taking into consideration public accessibility of social media, it is expected that the announcements efficiency will not considerably change in the next period. Further improvements of the Ministry of Defense and the Serbian Armed Forces presentation can be achieved in direct communication with members of the public in social network. It is also important to prepare a good analysis of the influence that certain public media can have on the shaping of public opinion.

REFERENCES

Bonsón, E., Torres L., Royo S., Flores F, (April, 2012 Local e-government 2.0: Social media and corporate transparency in municipalities, *Government Information Quarterly*, Volume 29, Issue 2, 123–132.

Bobar Z (2009) Servisno orijentisani model eUprave sistema odbrane, (in Serbian) magistarski rad, Beograd.Fakultet organizacionih nauka

Fyfe, T, Crookall, P. (2014) Social Media and Public Sector Policy Dilemmas, Canada. Toronto. *IPAC-Institue of Public Administration of Canada*

Đurić-Atanasievski, K. (3/2013) Komuniciranje i demokratija u 21.veku,*(in Serbian).Srpska politička misao*, Vol 41, 133.

Đurić-Atanasievski, K., Bobar, Z., Krivokapic J. (2012). Communication management and Information Technology – An Example of the Use of Social Networks in the Defence Structure, paper presented at Symorg 2012

Karakiza, M. (February 2015). The Impact of Social Media in the Public Sector . *Procedia - Social and Behavioral Sciences*, Volume 175, 12, 384–392.

McNair M. (2005*) Nove tehnologije i mediji* (in Serbian) ed.Birgs A, Kobli P, Uvod u studije medija. Beograd, Clio

Mergel I. (2012) *Social Media in the Public Sector: A Guide to Participation, Collaboration* ...New York, John Wiley & Sons

Mergel, . (2013): A Framework for Interpreting Social Media Interactions in the Public Sector, in: *Government Information Quarterly*, Vol. 30, Number 4, 327-334.

Mayfield III, Thomas D. (2011). A Commander' s Strategy for Social Media, *Joint Force Quarterly*. 2011 1st Quarter, Issue 60, 79.

Picazo-Vela S, Gutiérrez-Martínez I, Luna-Reyes LF, (October 2012) Understanding risks, benefits, and strategic alternatives of social media applications in the public sector *Government Information Quarterly*, Volume 29, Issue 4, 504–511.

Report of congruence of web presentations of government acencies with document Guidelines on web presentations of government services, agencies of territorial autonomy and local self-governing unit,

Directorate for Digital Agenda of the Ministry of State Administration and Local Self-Government, May 2015
NATO Public Affairs Handbook, 2010, www.shape.nato.int/public-affairs-handbook
United Nations, E-Government Survey 2012
https://publicadministration.un.org/egovkb/Portals/egovkb/Documents/un/2012-Survey/Complete-Survey.pdf (04/05/2016)
The User Challenge Benchmarking The Supply Of Online Public Services (2007), Capgemini, 2007 https://www.capgemini.com (03/10/2015)
https://stats.oecd.org/glossary/detail.asp?ID=4752
http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTINFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/EXTEGOVERNMENT/0,,contentMDK:20507153~menuPK:702592~pagePK:148956~piPK:216618~theSitePK:702586,00.htm

RESHAPING THE FUTURE OF COMMUNICATION BY RESHAPING CRM

Tijana Jugovic[1], Dejana Milosev*[1], Valentina Vukmirovic[2]
[1]Faculty of Organizational Sciences, Faculty of Organizational Sciences
[2]Faculty of Organizational Sciences
*Corresponding author, e-mail: milosevdejana88@gmail.com

***Abstract**: This paper aims to clarify the notion of CRM, as well as the influence of this system on how communication with customers will be shaped in the future. Through CRM and systems used to facilitate CRM, companies find out more about their target audiences and the best way to meet their requirements, so that they may improve communication with existing and potential customers. Operational CRM consists of three main components: sales automation, marketing automation and service automation. Therefore, this paper will focus on better explaining these concepts, as well as on examining the future of CRM and the way this system may contribute to the better placement of products or services of certain companies on the market. The influence of CRM systems on customer satisfaction is also explained, as well as the future of communication between the companies and the customers.*

***Keywords:** CRM, communication, customer, marketing*

1. INTRODUCTION

The speed at which the client is approached and meeting the demands of clients have become the key parameters of a company's successful management, where the most significance is placed on recognizing the needs of clients and fulfilling them as quickly as possible. *Severovic (2013) point out that: "companies meet the demands of a competitive market by constantly reaffirming their position when compared to their competition" (p. 143).*

The concept of customer/client relationship management is essential in contemporary business practices. Customer relationship management directly correlates with marketing, i.e. sales. Satisfied customers are the instrument through which successful contemporary business subjects are realized, especially in today's modern terms of business, where the competition is undoubtedly stronger than ever before. There are numerous definitions of the concept 'customer relationship management'. Although customers are in fact managed by having their needs satisfied, and thereby building a long-term partnership between the customer and the provider, there are also some authors who speak of managing buyer relations, rather then managing customer relations.

Severovic (2013) point out that: "customer relationship management (CRM) represents the company's approach to managing and interacting with existing and future customers" (p.157). The CRM approach sets out to analyze data about the clients, in order to improve the company's business relations with them, with a particular emphasis on keeping a customer in order to boost sales

While developing customer relationships, technology, i.e. communication technology based on the support of the internet, has a significant role. It not only makes communicating with potential customers possible, but it also allows companies to develop long-term relationships with them, based on constantly monitoring their needs (Yeung., M . & Ramasamy., B., 2008).

One important aspect of the CRM approach is that CRM systems integrate information from a variety of different sources, including the company's website, telephone line, e-mail, live chat, marketing materials, social media, and many others. Through the CRM approach and the systems used to facilitate CRM, companies find out more about their target audiences and the best way to satisfy their needs. However, adopting the CRM approach may from time to time lead to favoring certain

categories of customers, which in turn may cause dissatisfaction in many other customers and defeat the purpose of CRM in general.

CRM system's primary goal is for the company to integrate sales automation, as well as marketing and customer support. This is why these systems usually have a control panel which allows them to have a general overview of the three functions on one page, for each customer that the company may have. Control panels provide information about clients, sales, previous marketing activities and more, by summing up all relationships between the clients and the company (Kostic-Stankovic, M. & Filipovic, V., 2014).

Operational CRM consists of three main components: sales automation, marketing automation and service automation. Here we will aim to explain these notions more closely, as well as to examine the future of CRM and the way in which this system may contribute to the better placement of products or services of certain companies on the market.

2. SALES AUTOMATION, MARKETING AUTOMATION AND SERVICE

Sales automation occurs in all stages of a sales cycle, from the initial contact to the moment in which a potential client becomes an actual client. For example, in August 2000, Oracle came out with a CRM software package, OracleSalesOnline.com, that made contacts, schedules and performance monitoring available online, so that the required information about customers was easily accessible to all employees working in an office or in the field.

Sales automation conducts an analysis of sales for promotional purposes and it automates monitoring clients with a history of repeated and potential future sales. It also coordinates sales and marketing departments, call centers and retail stores. This helps prevent a double effort in order to establish communication between the sales representative and the customer, and it also automatically tracks all communication on both sides (Kumar, V. & Reinartz, W. 2012).

Marketing automation is focused on modifying the entire process of commerce, in order to make it effective and efficient. For example, by keeping scores of the customer's behavior, Salesforce Marketing Cloud allows for the marketing campaign to adapt to the customer's engagement in the transaction.

Kostic-Stankovic (2013) point out that: "CRM marketing automation tools can automate repeating tasks, such as sending out e-mails to customers at a certain time or posting marketing-related information on social media" (p. 113). The goal of marketing automation is to turn a sales advantage into the largest number of active new buyers possible. CRM system works on engaging customers through social media even today.

Service automation is a part of the CRM system focused on the direct technology of the customer service. Thanks to service automation, buyers receive support through multiple channels, such as a telephone line, e-mail, knowledge base, ticket portals, frequently asked questions section, etc. For example, Microsoft's Dynamic CRM Software monitors the time and the resolution of calls in order to improve the efficiency of particular customer services.

Analytical CRM. The role of analytical CRM systems is to evaluate customer data gathered through a variety of sources, so that business managers can make informed decisions. The analytical CRM system uses techniques such as data mining, correlation and shape recognition, in order to analyze customer data. This sort of analytics helps the company improve its services by identifying minor solvable issues in the marketing sector, which are in relation to different kinds of customers who need to be approached in different ways.

For example, by analyzing the customer base, which is in relation to customer behavior while shopping, the company can see if a certain buyer has not been buying a lot of products recently. After this sort of data is scanned, the company may choose to take a different approach to that particular

group of customers, so as to present its products or services more effectively and show the customer what may be of use for them (Keller, L. & Kotller, Ph, 2006).

Mutual Fund CRM. The third primary goal of the CRM system is to include external partners, such as suppliers, salespersons and distributors, and then share customer information throughout the organization. For example, the feedback may be received through technical support, which deals with customer calls, and could help to give instructions in relation to the placement of products and services to that particular customer in the future (Draganic, D., 2013).

3. CRM SYSTEM'S MAIN COMPONENTS

CRM system's main components are building and managing customer relationships through marketing, observing these relationships in various stages, managing these relationships in every phase and recognizing the fact that the distribution value of this relationship of the customer towards the company is not homogenous. When building and managing customer relationships through marketing, companies may benefit from using different tools that facilitate the organizational design, stimulating programs, recognizing customer structures, all with the goal of optimizing the reach of their marketing campaigns. By acknowledging different CRM stages, companies can benefit from perceiving multiple interactions as linked transactions. The final CRM factor emphasizes the importance of CRM by calculating the profitability of client relations. By studying the particular habits of customers, the company will be able to dedicate various resources and attention to certain kinds of customers (Kracklever, A. H., 2004).

Relational intelligence, i.e. the consciousness about different relationships that the customer may have with a company, is an important component of CRM's main stages. Companies can be successful in recording demographic data, such as gender, age, income and education, and then integrating them into the information regarding purchases, so as to categorize clients by levels of profitability, but this is only a company's mechanical view of client relationships. This is a sign that companies always see customers as resources that can be used in up-sell or cross-sell situations, and not as people in search of interesting and personalized interactions.

Figure 1: *Components of CRM. (2016, May 15)*

4. THE INFLUENCE OF CRM ON CUSTOMER SATISFACTION

Customer satisfaction has significant implications for the economic performance of a company, as it can increase the loyalty of customers and reduce their complaints, as well as the possibility of losing a customer. Implementing the CRM approach is likely to have a positive influence on customer satisfaction and client knowledge in relation to the offer on the market and the purchase for various reasons.First of all, companies are able to accommodate their offers to each customer. By accumulating information through client interaction and the processing of this type of information, all with the goal of discovering different patterns, CRM implementation helps companies adapt their offer so as to suit individual tastes of their clients. This kind of adjustment improves the client's impression regarding the quality of the product and the service, and since it is that impression about the quality of the product that determines the level of customer satisfaction, it thereby follows that CRM implementation has a positive influence on customer satisfaction indirectly.

CRM implementation also enables companies to process buyer and client requests and demands precisely and in a timely manner. For example, Piccoli and Applegate discussed how Windham uses IT tools to deliver consistent service experiences to customers. Both companies improved their ability to adapt and decreased the variability of the customer's experience in relation to their view of the quality of the product (Kotler, Ph., Wong, V., Saunders, J. & G. Armstrong., 2006).

5. ADVANCING CRM SYSTEMS

The consulting firm Bain & Company claims that it is important for companies to establish strong CRM systems in order to improve their relational intelligence. According to this argument, a company has to admit to people having different kinds of relationships to different brands. One study analyzes relationships among customers in China, Germany, Spain and the United States to over 200 brands in 11 industries, including airlines, automobile factories and the media. This information is valuable because it provides insight into the demographic data, different behaviors and values on the basis of customer segmentation. These types of relationships can be both positive and negative. Some customers view themselves as being brand-friendly, others feel repulsion towards brands, while some have mixed feelings about them. These relationships can be distant, intimate or something in between (Maggon, M., Chandhry H., 2015).

6. INFORMATION ANALYSIS

Based on this information, managers should understand the various different reasons behind a particular kind of relationship and provide the customers with what they are asking for. Companies may gather this type of information through polls or interviews with existing customers. For example, Frito-Lay conducted numerous ethnographic interviews with its clients, in an attempt to understand their relationships to companies and brands. One of the things they discovered was that the majority of grown-up customers use their products in order to feel playful. They may have enjoyed the orange lighting of the company or some interesting shapes. Companies have to improve the relational intelligence of their CRM systems. These days, companies gather and receive large quantities of data through e-mail, online sessions, telephone calls, etc. Many companies handle these large quantities of data incorrectly. These are all signs of the type of relationship that the customer wishes to have with a company, which is why companies should consider the possibility of investing more time and effort into developing their relational intelligence further.

Companies may use the data mining technology and internet searches to understand the relational signals. Social media such as Facebook, Twitter, blogs, etc. are also a very important factor in gathering and analyzing information. Understanding existing clients and gathering this kind of data allows the companies to understand the desires of potential customers and their relationship to the brand (Kostic-Stankovic, M., 2013).

It is also very important to analyze all this information in order to establish which relationships have proven to be most valuable in terms of certain categories of customers. This is helpful so as to turn

the gathered data into profit. Stronger relationships to customers contribute to a company's better placement on the market. By managing different portfolios for different segments of a client base, i.e. client category, a company may achieve its strategic goals.

7. EMPLOYEE TRAINING

Many companies also conduct training programs for their employees, whose main goal is to teach them how to identify and efficiently create reliable customers, i.e. brand relationships. For example, Harley-Davidson sent its employees on a trip with clients, all motorcycle lovers, in order to strengthen their relationship to them. Other employees receive training in the areas of social psychology and social sciences, so as to help consolidate client relationships. Representatives of a customer service have to be educated and able to appreciate client relationships, but at the same time, they need to be trained so as to understand the profiles of existing customers. Even financial and legal services should undergo training about the way in which relationships with existing and potential customers should be managed and built.

8. EVALUATING PRECESSES AND PLANNING NEW PROCESSES

Many companies that do not have a well-thought-out and logical process cannot be successful in achieving their goals. Companies have to define their business goals and evaluate their CRM processes in order to improve and expand the business so that it may suit their needs. The implementation of new technologies is also useful because the use of CRM systems requires changes in the infrastructure of the organization, as well as the development of new technologies, such as business rules, databases and informational technologies (Buckingham, R., 2011).

9. CONCLUSION

Customer relationship management (CRM) represents a company's approach to managing and interacting with current and future clients. The CRM approach aims to evaluate client data so as to improve business relations with customers, with a particular emphasis on retaining old customers in order to boost sales. An important aspect of the CRM approach is the fact that CRM systems integrate information from a range of various different channels, including the company's website, telephone line, e-mail, live chat, marketing materials, social media, and many others. Thanks to the CRM approach and the system used in order to facilitate CRM, companies discover more information about their target audiences and the best ways to meet their requirements.

The primary goal of CRM systems is to integrate and automate sales, as well as marketing and customer services.

By acknowledging different stages of CRM, companies will be able to benefit from perceiving various different interactions with customers as linked transactions. By studying the particular habits of customers, companies will be able to dedicate different resources and attention to certain kinds of customers.

Many companies also conduct training programs for their employees, so as to teach them how to recognize and efficiently encourage the increase in the number of their customers, i.e. brand relationships.

Companies should define their business goals and evaluate their CRM processes in order to improve and expand business so that it may suit their needs. The implementation of new technologies is also useful because the use of CRM systems requires changes in the infrastructure of an organization, as well as the development of new technologies, such as business rules, databases and informational technologies.

REFERENCES:

Buckingham, R. (2011). Customer Once, Client Forever. Washington: Kiplinger Books.

Draganic, D. (2013). Customer Relationship Management. Split:Faculty of Economics .

Dukic, B., Gale .V. (2015). Customer relationship management in the function of customer retention. Fairfield.

Filipovic, V., Kostic-Stankovic, M. (2014). Marketing Management. Belgrade: Faculty of Organizational Sciences.

Goldsmith,M., Ronald, E., Leisa, R., Flynn, and Ronald, A. Clark (2014). The etiology of the frugal consumer. Journal of Retailing and Consumer Services, Vol. 2, Issue 7, 12-17.

Kostic-Stankovic., M. (2011). Integrated business communications. Belgrade: Faculty of Organizational Sciences.

Kostic-Stankvic. M., (2013). Marketing communication in managing relationships with customers. Belgrade: Foundation Andrejevic.

Kotler, Ph., Keller K. (2006). Marketing Management, Belgrade: Data statut.

Kotler, Ph., V. Wong, J. Saunders, G. Armstrong. Fundamentals of Marketing, Zagreb:Mata,.

Kracklever, A. H. (2004). Collaborative Customer Relationship Management. London John Wiley & Sons,.

Kumar, V., Reinartz, W. (2012). Customer Relationship Management. London: Pilgrim.

Laney, D. (2001). The Great Enterprise Balancing Act: Extended Relationship Management (XRM). META Group,Vol. 3, Issue 7, 15- 21..

Lovreta, S., Petkovic, G., Berman, B., Veljkovic, S., Crnkovic, J., Bogetic, Z. (2010). Customer Relationship Management. Belgrade: Faculty of Economics,.

Maggon, M., Chandhry H. (2015). Revisiting Relationship Marketing and Customer Relationship Management in Leading Tourism and Hospitality Journals: Research Trends From 2001 to 2013. Journal of Relationship Marketing Vol.14, Issue 1, 32-39.

Severovic, K. (2013). Doctoral thesis: Client relationship management as a source of information in order to shape and improve services. Varazdin.

Yeung., M . and Ramasamy., B. (2008). Brand value and firm preformance nexus: Further empirical evidence. Journal of Brand Management Vol. 15, Issue 5, 43-49.

www.enmain.com (2016, May 15)

BRAND DESIGN IN FUNCTION OF SUSTAINABLE CUSTOMER COMMUNICATION DEVELOPMENT

Milica Kostić-Stanković*[1], Valentina Vukmirović[2]
[1]University of Belgrade, Faculty of Organizational Sciences, e-mail: milicak@fon.rs
[2]University of Belgrade, Faculty of Organizational Sciences, e-mail: valentina.vukmirovic91@gmail.com

Abstract: *Even though it should be logical that process of product selection while purchasing is based on simple ratio of price and quality, practice indicates that, in numerous cases, brand design and communication with customers are decisive factors in product purchase decision making. Reasons are very logical and connected with human psyche, as well as manner of perception and notion of different messages sent by brand itself. This is exactly the reason why, while creating brand identity,its aspects such as visual identity, image, brand tone and message, are thoroughly examined and why customers are consulted before and after creating conceptual solution. Based on above mentioned observation, this paper considers significance of branding concept and role of design as a source of sustainable communication development. Research on significance of these components was conducted in paper by applying quantitative method (questionnaire). Research is presented through result analysis and conclusions of primary study, which verify above mentioned claims.*

Keywords*: Brand, design, added value, emotional benefits, product visual identity, customers, sustainablecommunication.*

1. INTRODUCTION

Leading companies worldwide have been paying great attention to the design of their products with the aim of creating successful commercializationon the global market. (Novaković, 2002)In modern world, no company can succeed unless it is in constant touch with the outside world through design and brand. Brand purpose is to create unique rational and emotional associations among customers since they are of great significance when it comes to making decisions about purchasing products. (Cicvarić, 2006) Innovative design is becoming more and more influential on customer's desire to purchase a product as well as on loyalty to a company. The ability to solve problems in communication, including problem identification, research, analysis, solution generation, prototype creation, consumer testing and results evaluation, represents the significant contribution of the design in creating a special connection between producers and customers. (Kuzmanović, 2008)

The broader comprehension of the issues related to customers' expectations regarding cognitive, social, cultural, technological and economic contexts of the design is becoming a prerequisite for creating higher quality communication capacities of the brand. Therefore, the aim is to establish the significance and influence of the design, as a key brand component, on the creation of sustainable communication and its constant promotion in the process of brand creation. The fact that this issue has not been addressed properly in our society, compared to more developed ones, adds significance to this research. Design innovations have recently had great influence on increasing brand value as well as product's competitive advantage. Since brand represents an instrument of competitiveness, which has an important role for gaining leadership position on the market, it is vital to constantly introduce innovations in all business processes. (Kotler, 2005) In that way only can the costs be reduced and revenues augmented, with the aim of improving business results and increasing the competitive capacities of a company. Branding strategy based on future goals which include final customers, raising awareness of the brand, its positive image creation and building a loyal relation with the brand, is of great importance. Standard scientific research methods such as inductive, deductive, analytical and synthetic methods, as well as statistical and comparative analysis were used in this paper. Domestic and foreign references, as well as electronic resources will be critically analyzed, with the aim of gaining new scientific and expert knowledge on business practice. Empirical research was conducted by using methods of surveying, interviewing and effect measurements.

2. DESIGN AS A BRAND FACTOR

Design, viewed in its broadest meaning, represents visual, functional and qualitative modelling of the overall life conditions of the society.(Filipović, Kostić-Stanković, 2009) Design is supposed to contribute to creating functional aesthetically acceptable products of high quality, while at the same time achieving optimal cost-effectiveness and productivity in business. Design was made because of the need to create visual identity of the product which is the sum of different means that in artistic and graphical way create unique representation of a product, or a whole brand to which several lines of products belong, or even a certain corporation and its activity. The process of designing is realised through problem definition, relevant information gathering, generation of several preliminary designs, final design analysis and selection, and finally its testing and implementation. The aim of every company is to get public favour with its unique visual identity, and then to take its place on the market through consistency in representation of its advantages and quality. It is very important to pay close attention to cosistent use of the carefully designed visual identity components, with which wide recognition and differentiation on the market is achieved. The search for media values forced the companies to rely less on conventional means of advertising and to accept other communication forms: design, sales promotion, direct marketing. (Lamb, Hair, McDaniel, 2005) Nowadays, the focal point of innovation in the design section is a human – or, to put it differently, design should question human needs and, accordingly, ensure functionality, possibility of marketing positioning, product usability and sustainability. The visual identity of a product and visual elements of a brand have become only one of its dimensions nowadays. The strict division of technical disciplines into industrial and graphical design has been replaced by interdisciplinary practice of strategic design which uses new forms of design with the aim of creating a product as the means of communication with the customers.(Lamb, Hair, McDaniel, 2005) Design is supposed to create and develop a visual solution for problems in communication between the brand and customers, including the comprehension of typographical and aesthetic elements, their composition and structure. Mass messaging is being transformed into narrower communication forms intended for specific audience, i.e. special interest design, which is supposed to provide the insight into the target customer groups, is developing. Additionally, new concepts of marketing strategy are about including customers in the brand values creation and the products that it covers. In business, innovative design can provide long-term competitive advantage sustainability and quality communication between brand and customers which leads to the creation of superior organization performances. (Kotler, 2005) Designing a product is a dynamic process constantly being updated with new innovative ideas in order to satisfy customers' needs and requests as well as to build long-term relations. Therefore, design is becoming a strategic resource form which is important for value creation since it has a decisive influence on the initial concept and the delivery of product and services which fulfill customers' needs and aspirations. The aim of the design is to connect the brand with the customer in a visually sophisticated way, thus separating it from the competition and differentiating its offer. Brand has to induce satisfaction in customers. Therefore, motivational researches are being carried out, and they are supposed to provide the answers to the question of customers' needs, desires and aspirations, based on which a design for a specific target group is created. Considering the fact that the visual elements language is understood much faster and easier than a verbal language is, visual elements of the brand identity are applied to all the components through which a company communicates with the general public. The color of the brand represents the mark of its visual identity which contributes to the higher level of recognition of the brand name and sign in relation to the competition. The purpose of the color is to communicate the essential information to the customer; it triggers certain reactions and stimulates thoughts, memories and different perceptions. (Gobé, 2006) The color has the crucial role in the process of brand evaluation and customer's final decision making whether or not to purchase a product. In brand creation, the knowledge and proper usage of colors is demanded, as they have highly associative and symbolic meaning. We are talking about visual, aesthetic and identification element that can cause different associations in different countries. (Rakita, Mitrović, 2007) Companies pay close attention to colors while designing brand elements, especially if they are present on the international market. Brands use different colors and nuances as standards for their visual application, all of which contributes to brand consistency and recognition. In the process of brand management, the packaging has an extremely significant role since it stimulates associations with the brand. Furthermore, the packaging design represents visual means of communication with the customers which makes it easier for them to recognize the products of certain purpose, kind and price.(Cicvarić, 2006)As well as having a practical value, design of the packaging has an emotional value. Actually, it is supposed to have a strong visual influence on the customer. The packaging directly influences brand image creation and therefore represents an important instrument for communication in marketing. (Filipović, Kostić-Stanković, 2009) As an instrument for communication with the customers, the packaging is used as a transmitter of the message about brand value, emphasising its recognition elements and attractiveness. The packaging design and the way of marking a brand influence the process of brand identity creation so that the original packaging will draw the customer's attention and stimulate impulsive purchasing. (Mandarić, 2012)

3. THE ROLE OF BRAND IN MODERN BUSINESS

In order for it to be successful, a company has to differentiate its offer and to position itself in relation to the competition so that the customers would perceive the difference between its and competitor's offer.(Milisavljević, 2013) Market trends which are conditioned by quickened development of technology, such as the mass production of the products having the similar or even same purpose, shortening product life-cycle, as well as accelerated product obsolence have resulted in the inefficiency of the marketing concept based solely on emphasising the functional advantages of the product and rational reasons for the purchase. Therefore, a company ought to strengthen its advantage in the intangible market-based assets. It led to the necessity for brand creation and the development od its management concept. The purpose of this form of communication is creation of atmosphere, emotions and associations with the customers related to a certain brand, no matter if it is a company, product, service idea or person. (Vlastelica, 2007) Brand has a deep set of thoughts and associations within itself; it has to provide some kind of additional value to the consumer. So, it may be said that the brand represents the way in which customers experience, perceive and understand a specific brand in all its dimensions.(Veljković, Đorđević, 2009) Brand can be defined as a recognizable group of elements: name, logo, design, person and message. The aim of all these is to identify and differentiate organizations, products, services, places and ideas.(Cicvarić, 2006) Unique combination of basic brand elements causes rational and emotional associations, beliefs and expectations in consumers / buyers / users. Brand elements are the basis for product identification and differentiation. However, the most important thing here is to establish emotional connection with the buyer. The fact that the famous designer Marc Gobébelieves that we live in the age of "emotional economy" whose vision is to "make the surroundings more pleasant, exciting and precious place for us all“ only proves this statement. (Gobé, 2001). Brand is a very important source of competitiveness because it enables keeping the existing buyers and attracting new ones. In modern business conditions, general public is faced with different manifestations of brand. It can be represented in the form of product branding, service branding and corporate branding, as well as co-called private branding or trademark, with the obligation of observing the image of the country of origin, or should we say its influence on the brand. (Veljković, Đorđević, 2009) Persons, places and organizations, sports, art and entertainment, countries and different geographical locations, information, ideas can all become a brand. (Filipović, 2008) From all the above said, it can be concluded that nearly everything can be branded, which is viewed as a chance for achieving better business results because brands enable the consumers to develop higher level of loyalty and affection for certain products and services. The value of the brand is based on the difference in consumers' reactions which represent the result of consumers' knowledge on the brand comprising of thoughts, feelings, images, experience, beliefs etc. Different consumers' reactions, which actually create brand value, reflect in perceptions, preferences and behavior in accordance with marketing aspects of a specific brand. (Novčić, Damnjanović, Filipović, 2012) Brand is thought to have a positive value based on customers if the customer has a positive reaction on the brand and the way it is launched in the situations when it can be recognized, unlike in those when it cannot. The benefit of brand existence can be considered from the customer's and organization's point of view. The advantages that the brand offers to customers are multiple. Brand identifies the source of the product, and it provides the customer with the possibility of allotting it certain responsibilities. Brand also facilitates the process of decision making on the selection of the product and it reduces the research costs related to product internally, through time needed to be spent on thinking, and externally, through time needed to be spent on product search. From the aspect of organization, a properly created brand will promote the company into a recognizable player on the market in relation to other business partners. Also, a certain degree of differentiation is achieved in relation to the competition, which can be seen as an indicator of high quality by customers. Provided that brand characteristics satisfy customers' needs and desires, customers will certainly opt for different products of the same brand thus building loyal customer – brand relation. On the basis of loyalty, a constant need for the product is developed, which is how brand proves to have economic benefits. According to the above mentioned facts, the following conclusion can be drawn: brand has economic and social contribution. The social contribution is perceived through generating customers' loyalty which leads to producing a stable revenue for the company, or in other words, economic contribution. Regular and steady revenue generates steady income for all the company's employees which is an extremely valuable social contribution.

4. SUSTAINABLE COMMUNICATION AND BRAND IN FUNCTION OF CREATING RELATIONSHIP WITH CUSTOMERS

Sustainable communication is firmly connected with strategic customer relationship management, which can be defined as a marketing approach towards managing company's interaction with current and potential customers. (Hasty, Reardon, 2007)Sustainable communication implies long-term coordination of organizational structure business strategies and corporate culture with customer data and information

technology with the aim of satisfying customer needs and achieving business profit. (Shimp, 2003) Therefore, sustainable communication implies gathering information from all sources inside the company, as well as outside the company, which implies customer feedback and activities of competitive companies. This enables company's marketing experts to make proper decisions rapidly and effectively to fulfill customer needs, due to the fact that satisfied and loyal customer is far more interested in creating long-term relationship with certain company and its products. Communication specialists agree that, besides costs reduction, there should be three new priorities in creating relationship with customers: a) increasing services level and quality; b) increasing competence level, in order to provide business partners and customers with quality responses to additional requirements and c) active usage of social networks in communication with clients. (Levine, 2007) Due to the fact that their consumers are becoming more demanding, better informed, and in a certain manner even suspicious about the quality of a product or service, successful companies are trying to improve their relationship with customers by providing them with extra value, such as different personalized gifts, for example multipurpose loyalty cards, different discounts for special occasions, or providing customers with post sale activities such as servicing. (Filipović, Kostić-Stanković, 2009) However, by conducting this kind of activities, company is gathering valuable information about demographic structure as well as preferences, interests and life styles of their customers, which are of outstanding significance in product development. Other authors suggest that sustainable communication has five crucial tasks: a) encouraging new forms of customer behavior, b) placing customer in center of marketing activities, c) combining different messages and media for achieving desired communication effects, d) developing strong and unique brand image, e) developing long-term relationship with customers.(Hasty, Reardon, 2007)

In the conditions of modern market environment, one of the main prerequisites for a successful business is to establish high quality communication with the target groups, particularly with the buyers or service consumers. The understanding of the growing importance of the communication for the company's market success has contributed to positioning this business function amongst the top priorities of the company's organizational structure and affecting its strategic decisions.(Mitić, Ognjanov, 2013) Brand creation is one of the ways to establish and maintain communication between a company and the customers since brand is not only about a product's or a company's name but it also includes a complex functional end emotional structure. Nowadays, consumers are overcommunicated as a large number of information is directed towards them on a daily basis, they are exposed to information from 40 billion webpages and hundreds of television channels as well as thousands of newspaper headings. (Cicvarić, 2006) Thus, the process of perceiving and processing different information is greatly facilitated with the existance of brands. Even though the purpose of the brand is to identify products and services, as well as their producers, it can also be used to identify customers which enables the establishment of communication system and connection wiht other people who are the consumers of the same brand.

Brand is created through different communication forms which is a key factor in establishing a connection between brand and customers. Firstly, it is necessary to define and adopt brand identity which is followed by the analysis of the manner of communication with the customers. The communication on brand – customers relation begins from the moment the customer becomes aware of the brand and that communication is maintained through marketing and corporate communication activities. (Cicvarić, 2006) With the aim of achieving the desired brand communication effects, it is necessary to create communication programmes from customers' or target groups' point of view, in accordance with their needs, desires and characterisitcs. Successful brands communicate with their customers, listen to and learn from them preserving the possibility to transform and adapt to different target groups segments. While planning sustainable communication between brand and target groups, it is important to devise a certain creative style of sending the desired messages to the customers, which will depend on identified target groups' characteristics. The aim of the communication activity is to inform the customers and other groups of interest and to draw customers' attention which will stimulate them to purchase and create a long-term position of the brand in customers' consciousness. Communicational brand mixture comprises elements of integrated marketing and corporate communications.(Cicvarić, 2006) The same author states that the aims of marketing communication are to inform the customers about the products, services and sales conditions, to assure the customers to choose a certain product and to stimulate the customers' reaction to their organization's products. For successful realization of integrated marketing communication it is necessary to determine goals to be achieved, define program and financial funds needed for its realization, to observe the achieved results and to take the corrective action if necessary. Integrated marketing communication is realized through combined and coordinated usage of marketing activity instruments, such as: advertising, sales promotion, personal sales, packaging design, sales environment etc. (Vasiljev, 2001) Corporate communication, as a significant business function within modern companies, is comprised of activities directed towards creation of organization's corporate identity, corporate brand and company's reputation. Due to its complexity, brand development is an important element in the process of creating corporate reputation. The reason for that is the fact that the mere implementation of promotional activities is not sufficient for building a quality and long-term relation between an organization and the customers, since they are already exposed to a large number of information and they trust less to the content placed by mass media. (Macura, 2001) One of the most straightforward ways of establishing an immediate dialogue with the customer is to revive and humanize the

brand, i.e. to create brand personality as an integral part of communication strategy. (Starčević, 2012) The idea of brand personality creation was formed on the basis of the understanding of the interpersonal relations significance. The brand personality is its important aspect and has a crucial part in creating the relation between brand and customers since it provides basis to the customers to easily connect to and even identify with. Customers purchase a certain brand to express their own identity or image through it.
Numerous researches have shown that creation of a proper brand personality leads to establishing strong relation between customers and brand, as well as to other significant marketing outcomes such as easier brand recall, stronger and more positive attitudes towards brand, stimulations of purchase intentions, consumers' increased brand loyalty and augmented brand market value. (Starčević, 2012) The message of the brand comprises all ideas, concepts and symbols which an organization sends to chosen target audience. Its primary mission is to draw attention to the brand, to attract the customers who will become and remain loyal to the brand. If a product and its packaging are used as a means of communication, it is necessary to harmonize the typography, color, illustrations, shape and material in order to make a compact unit which transmits a unique message. (Kotler, 2003)

5. EMPIRICAL RESEARCH

The aim of the research conducted in the period between March and April 2016 was to determine the influence of brand design and its communicational capacities on the decision making about purchasing a product. 230 customers were surveyed on the territory of City of Belgrade, out of whom there was a higher percentage of women (63%) than men (37%).
The research was conducted using a personally delivered questionnaire. During the survey, some useful additional information was gathered through personal communication between the surveyor and the interviewee. The aim of the research was to determine which brand elements have the crucial influence on the decision making about purchasing a product.
In order to obtain the wanted results, the interviewees were offered two competing products – instant coffee by two renowned producers: *Nescafé*and *Grand* coffee. The reason for choosing this product is the fact that it is in every-day use and that it is bought because of habit. Additionally, this category of product is interesting because the Serbian market in the segment of traditional coffee brands is a certain phenomenon – annual coffee consumption is 4.5 kg per capita. Over 33 000 tons of this beverage are sold in Serbia (http://marketnetwork.rs/). The above mentioned brands are chosen because they have been listed as the favourite ones in the various opinion polls conducted in Serbia. Serbian consumers perceive *Nescafé* brand as the highest quality producer in the category of instant coffee on the Serbian market for which they would opt if the finances were not an issue (ICERTIAS – International Certification Association GmbH, 2015). *Grand* brand is chosen because it has been at the top of the list of domestic coffee producers on the Serbian market. The research according to which every other cup of coffee that is consumed in Serbia comes from the factory of the company that owns this brand, only proves the statement above (http://www.profitmagazin.com/). Also, *Grand* coffee is the winner of *Best Buy Award 2015/2016 Millenials Serbia* in the category of instant coffee, as a producer with the best rate of price and quality on the Serbian market (http://www.advertiser-serbia.com/).
The questionnaire includes questions about brand design, visual characteritics of the products that this brand has under its umbrella and the interviewees' aspirations towards creative participation in the promotion of the brand (the suggestions were mostly related to the promotion of packaging shape and functionality, ant its aesthetic elements).
The results of the research showed that 80% of those who were surveyed consume a brand of coffee, 48% of whom do it more than one time per day. Coffee consumers are mostly up to 45 years of age. The consumers mostly consume black coffee or the so-called Turkish coffee (53%), which is probably caused by Serbian cultural heritage. The information that 92% out of 25 000 tons of coffee sold last year is "Turkish coffee" supports this claim. Instant coffee is in the second place with 34 %, while other kinds of coffee (cappuccino, espresso and a decaf) take only 13 %. Instant coffee is consumed mainly by younger population, usually at work, college or university or on the go.
The research has also shown that the consumers are generally loyal to brands, that they notice changes regarding prices or design, and emphasise that recommendations by friends and family members about which brand to use are important to them. Also, the interviewees stated that coffee consumption provides pleasure; it is a habit and a part of their lifestyles.
The results of the research have shown that consumers take care of which coffee brand they choose, because the majority of the interviewees express partial to complete loyalty to one coffee producer. Design of the brand elements greatly affects its position in the consumer's consciousness. Those who were surveyed emphasize that brand symbol generally causes specific feelings and associations. *Nescafé* brand symbol is perceived as modern, innovative, and well-adjusted to the contemporary man who chooses his coffee on the go in accordance with his lifestyle. This brand's logo appears stable and strong, and yet subtle enough to reflect its essence. *Grand* coffee brand's symbol is perceived as creative imitation of the *Nescafé* logo, primarily because of the white serif font on the red background. A portion of the interviewees noticed a

golden detail in the logo and understood it as an aspiration to visually stress and support the brand name, as well as to draw attention to the premium quality and brand's superiority over its competition. The interviewees think that most of the domestic and foreign coffee producers keep up to date with the latest trends when it comes to product's visual identity which positions *Nescafé* as the global market leader with the idea that they will thus increase the competitiveness of their products on the market.
For 32% of those who were surveyed, the color is of utmost importance when creating a brand and products under its umbrella, because for most people it is the sign of recognition, i.e. it facilitates detection among numerous competition products. Consumers are also sensitive to sudden and drastic changes in the design of brand elements and its products. This is proven by the results of the research according to which 36% of the interviewees completely agree that the change in their favorite coffee brand packaging design would affect their buying decision, since they are used to having some kind of certainty and constant values offered by the brand. Although the interviewees do not have doubts about the quality of domestic or regional brands, the foreign ones are preferred. Thus, as much as 78% would opt for *Nescafé* instant coffee than for the same product of the *Grand* Company. A portion of the surveyed consumers believe that foreign brands have better competitive position on the market because considerable funds are invested in the promotional activities and thus increase their visibility. They also think that *Nescafé* sets the trends when it comes to both product quality and its packaging design. According to the gathered data, it can be concluded that *Nescafé* is making competitive advantage on the market and is gaining its share of the market all thanks to its brand strength, quality and tradition, superb design and well-conceived strategy of communication with the consumers. The confirmation of this claim is the fact that 39% of the interviewees point out that the image of *Nescafé* brand is its primary advantage in relation to competition, to which visual characteristics of this brand products contribute greatly. When it comes to packaging design, the interviewees emphasize that they prefer lighter ergonomically designed *Nescafé* cans, as well as the fact that different kinds of coffee have different can color which makes the selection of the product easier. Those who participated in the survey often mentioned that red *Nescafé* mug associated them with the ritual of coffee drinking which they relate to relaxation and pleasant moments. It can be said that this creation of the *Nescafé* brand is itself some kind of a brand. On the other hand, quality and reliability are generally emphasized in relation to *Grand* brand, since it is, particularly among older generation, known as renowned coffee producer on the Serbian market. It is considered that this brand's and its products' visual identity should not be drastically altered since, as a part of the legacy of the old times, it adds to the product value. When the interviewees were shown the *Grand* instant coffee packaging they said that it greatly resembles the *Nescafé* product of the same category. In accordance with the above mentioned, 23% of the interviewees think that *Grand* company ought to decide on giving a specific identity to its products' packaging in order to be different from *Nescafé,* while only 7% of the enthusiastic consumers would participate in the creation of the product's design.
When it comes to communication with the consumers via traditional media, the interviewees think that *Grand* coffee has the best commercials on the domestic market because they are fine-tuned to specific target groups within consumer structure. Thus, the company creates the specific visuals for customers who recognize and choose premium quality, followed by a higher price of the product. The consumer structure is mainly comprised of younger female population for whom the messages have been created as well as the tone of communication, and of consumers who rely on traditional values and who pay special attention to commercials during New Year's holidays. Those commercials usually feature famous people or portray scenes from every-day life while family, neighbors and friends are having conversation with a cup of coffee at their side.

6. CONCLUSION

In order to achieve success in contemporary business environment, which is increasingly globalized, oversaturated and shaped by demanding customers with high expectations, company needs to establish and retain successful communication and long-term relationship with their target groups. Gaining and retaining confidence of target groups is a key to achieving business success, since customers create value for a company by choosing its products or services. Creating corporate or product brand could be an efficient method of establishing firm and long-term relationship with customers, due to the fact that brand is perceived as a guarantee of quality which shortens decision making process, but also as a manner of customer self-expression. By choosing certain brand, person can send specific message to the environment about his/her life style, preferences, interests, system of values, beliefs, etc. By giving the opportunity to send a message about who they are to the public, brand creates very deep emotional bond with customers which will ensure their affection for the brand and its products.
Since company's product is one of the most important means of communication with selected target groups, visual identity of a product, i.e. its design,is used in the process of brand creation.By creating unique brand and product design, company can provoke different emotions and imaginations among customers, but also send specific messages about brand essence and its identity. Main aim of design in process of brand development is to connect customers with the brand, and provoke their interest for the brand, which is the

first step towards creating loyal customer base. In circumstances of mega competition, innovative design can be a powerful asset for brand differentiation.

Based on above mentioned claims, it can be concluded that brand development, with process of design developmentas its core component, should be used as a strategic asset in process of creating sustainable communication with customers. This recommendation is based on results of theoretical and empirical research which was conducted by the authors of this paper.Research conclusions, which were presented in this paper, indicate that customers in Serbia significantly appreciate aesthetic and emotional brand components, and therefore perceive products of certain brands as high-quality ones. Due to the fact that domestic practice has, to a large degree, unfairly neglected brand and product design as a core element for accomplishing business success, authors recommend that aesthetic andemotional components in production sphere should gain adequate affirmation. Developing brand design could be a solution for better positioning and competitiveness of domestic brands and its products in Serbian and foreign markets.

REFERENCES

Charles, W., Lamb, J., Hair, J.,& McDaniel, C. (2005).*Marketing.* Belgrade, Serbia:Data STATUS.

Cicvarić, S. (2006).*Brand- Creating, positioning andretaining.* Belgrade, Serbia:Andrejević Endowment.

Filipović, V. (2008).*Brand management.* Belgrade, Serbia: Faculty of Organizational Sciences.

Filipović V.,&Kostić-Stanković M. (2009).*Marketing management.*Belgrade, Serbia: Faculty of Organizational Sciences.

Gobé, M. (2006).*Emotional branding.* Belgrade, Serbia:Mass Media International.

Hasty, R.,& Reardon, J. (2007). *Retail Management.* Boston, USA: Irwin/McGraw-Hill.

Kotler, F. (2005).*Lateral marketing.* Novi Sad, Serbia:Asse Books.

Kuzmanović, S. (2008).*Industrial design.* Novi Sad, Serbia: Faculty of Technical Sciences.

Levine, M. (2002). *Guerilla PR Wired: Waging a successful publicity campaign online, offline and everywhere in between.* Zagreb, Croatia: Profil International.

Mandarić, M. (2012).*Stratrgic brand management as a factor of company competitiveness.* Doctoral disertation. Belgrade, Serbia: Faculty of Economics. Retrieved from: https://fedorabg.bg.ac.rs/fedora/get/o:6282/bdef:Content/download

Macura, P. (2001). *Model of information system for promotional activities management.* Banja Luka, Bosnia and Herzegovina:Glas Srpski.

Milisavljević, M. (2013)Value Oriented Strategic Marketing. *QMJ – Quarterly Marketing Journal, 44(4),* 299-309.Retrieved from: http://www.sema.rs/repository/download/marketing-vol-44-no-4.pdf

Mitić S.,&Ognjanov G. (2013)Competitive Advantage and Corporative Communications. *QMJ – Quarterly Marketing Journal, 44(4)*, 343-353.Retrieved from: http://www.sema.rs/repository/download/marketing-vol-44-no-4.pdf

Novaković, Lj. (2002).*The influence of design on product competitiveness.* Belgrade, Serbia: Andrejević Endowment.

Novčić, B., Damnjanović V., &Filipović V. (2012): Brand positioning through banking services' offer- Serbian perspective. *QMJ – Quarterly Marketing Journal, 43(2)*, 121-132.Retrieved from: http://www.sema.rs/repository/download/marketing-vol-43-no-2.pdf

Rakita B.,&Mitrović I. (2007).*Brand management.* Belgrade, Serbia:Contemporary administration.

Vasiljević S. (2001).*Marketing principles.*Subotica, Serbia: Birografika.

Shimp, T.A. (2003). Advertising Promotion Supplemental Aspects of Integrated Marketing Communications. *Journal of Marketing Communications*, 10(4), 289-297.Retrieved from: http://eprints.uwe.ac.uk/14946

Starčević, S. (2012).*Creating and developing brand personality as a contemporary form of differentiation.* Doctoral disertation. Belgrade, Serbia:University Singidunum.

Veljković, S.,&Đorđević, A. (2009).Brand values for consumers and companies.*QMJ – Quarterly Marketing Journal, 41(1)*, 3-16.Retrieved from: http://www.sema.rs/repository/download/marketing-vol-41-no-1.pdf

Vlastelica, T. (2007).*Mediacampaign-Publicity and advertising.* Belgrade:Andrejević Endowment.

http://marketnetwork.rs/fmcg/intervju/1762-srpski-potrosac-je-zahtevan-i-lojalan; ac.; 05.04.2016.

http://www.profitmagazin.com/izdanja/broj_070.512.html; ac.; 11.04.2016.

http://www.advertiser-serbia.com/grand-kafa-instant-dobitnik-nagrade-best-buy-award/);ac.; 11.04.2016.

http://marketingitd.com/2014/omiljeni-brendovi-u-srbiji-moja-kravica-nescafe-nectar-minaqua-nivea-i-mercedes/; ac.; 12.04.2016.

EFFECTS OF BUNDLING NON-COMPLEMENTARY PRODUCTS – COMMUNICATION PERSPECTIVE

Vera Aćimović*[1], Slavica Cicvarić Kostić[2], Tamara Vlastelica[3]
[1]Leo Burnett Belgrade
[2,3]Faculty of Organizational Sciences, University of Belgrade
*Corresponding author, e-mail: vera.acimovic@leoburnett.rs

Abstract: *Product bundling is a very common marketing strategy. Bundles composed of similar, related products are prevalent in the market. However, there is a growing trend of bundling non-complementary, unrelated products. This paper aims to explore the ways of product bundling, with the emphasis on bundling unrelated products, and to identify possible effects from the communication perspective. We employed qualitative analysis of both secondary and primary data, gathered from specific campaigns in which one of the authors was engaged as account director for the projects presented as a case. One would expect that bundling benefits directly from higher degree of complementarity, but there are some circumstances where asymmetric bundles with lower degree of complementarity can help in reaching more consumers.*

Keywords*: bundling, product complementarity, communication channels, target audience, consumer electronics*

1. INTRODUCTION

Bundling of products by independent companies is nowadays a very common marketing strategy in several industries (Brito and Vasconcelos, 2014). Bundled products provide customers an opportunity to obtain a pair of products for a price lower than that of individual purchase. Examples of bundles can be, among others, found across following industries: telecommunications (handset and GSM package), food (coffee and concert tickets), electronics (microwave and recipe books) etc. (McCardle et al., 2006). Furthermore, there are examples within the service industry as well, such as bundling between hotels and restaurants, airlines and car rentals, public transport with museums (Armstrong, 2012). Michelin is considered to be a pioneer of bundling. When they launched the Michelin guide with information about petrol stations, accommodation and food, maps and directions, they bundled it with a tyre offer (Yan and Bandyopadhyay, 2011).

Sometimes manufacturers employ bundling strategies that are contrary to common practice. For example, inexpensive products (e.g. household cleaning products) are bundled with high-end products such as washing machines, vacuum cleaners or refrigerators (Samsung, LG), or dinners in restaurants with premium dinner-ware (Villeroy and Boch, Christofe, Wedgwood). Marketers can bundle an unknown product with a well-established one as a product launch strategy. Strong brands are an extremely valuable asset in bundling strategy, since their attractive attributes can affect quality perception of weak or new brands (Sheng and Pan, 2009). According to these authors, if a bundle contains a strong brand, the weak or new brand is most likely to be seen as representative of same category group as the strong one, for example “high end”, “quality” or “premium”.

Stremersch and Tellis (2002) provided comprehensive literature overview on the topic, indicated inconsistencies in definitions and terminology and presented a classification of various types of bundles with emphasis on the legal aspect of bundling. Gans and King (2006) describe the bundle as widely used business strategy where firms tend to obtain customers’ loyalty by offering interlocking discounts between particular brands or what seems as a pair of unrelated products. Bundling has also been identified as a tool for price discrimination, increasing market share and sales, product differentiation and competition reduction (Girju et al., 2013). Furthermore, bundling can help save transaction, packaging and advertising costs (Sheikhzadeh and Elahi, 2013) and serve well as mechanism for market entrance; all of this leads to increased profitability. The trend of using bundles increased over time due to an apparent emergence of packages consisting of a product and a service (Dukart and Swartz, 2000). Estelami (1999) researched bundle benefits and found out that the average saving when purchasing bundles goes up to 8%, affecting customers’ perception and evaluation of the bundle’s individual components. Bundling of products can also serve as a tool for new product introduction (Simonin and Ruth, 1995). An example of this is the launch of Samsung Galaxy S5 phone exclusively with Telenor, a mobile communications operator in 2014 on the

Serbian market. Bundling also occurs in mergers or strategic alliances, where firms can improve profits by bundling after integration (Mialon, 2014).

Apart from the benefits bundling strategies provide to companies, they are valuable for consumers as well. From consumers' perspective, bundled products provide the chance to pay less for a pair of products than the sum when purchased separately. Consumers then have a choice between meeting all of their requirements, which is rarely accomplished in the bundle, or purchasing items individually for a higher price (Brito and Vasconcelos, 2015).

Despite the fact that product bundling is a widespread business practice, there are a few researches and articles that deal with bundling unrelated products between two independent firms, especially when it comes to promotion. In this article, authors examine bundling of non-complementary products and its effects from the communication perspective. We employed qualitative analysis of both secondary and primary data of bundled offerings of electronics on Serbian market from February 2014 till February 2015. We examined bundles composed of product pairs. We consider that bundling of products of same quality is a natural scenario (Brito and Vasconcelos, 2014). Even when successful examples could be found on the market, it was most unlikely that a high-quality producer would be interested in making an alliance with a low-quality producer that would have likely harmed their reputation. We restricted research to two-item bundles, since they are most common on the market (Harlam et al., 1995). We considered two broad groups of products: consumer electronics and personal care. The results provide insights into good practices of bundling these classes of products.

This article is organized as follows: the next section presents definitions of bundling and introduces product complementarity in bundling. The following section develops a set of key propositions for bundling non-complementary products. The final section presents our conclusions, implications, and limitations.

2. BUNDLE COMPOSITION

In this section we investigate bundle components, types of bundles and product complementarity, whereas last has not received proper attention in existing academic literature, but may have major impact on bundle promotion.

2.1. Bundle terminology and definitions

According to Stremersch and Tellis (2002) there is no consistent, universally accepted definition of bundling due to lack of consensus in literature and proper use of terms, as well as vague distinction between important formulations and ambiguous domain of application. Adams and Yellen (1976) define product bundling as selling goods in packages. Guiltinan's (1987) definition considers bundling as a practice of marketing two or more products and/or services in a package for a special price. Recent literature still sticks to Yadav and Monroe (1993) definition, similar to the previous one, and sees bundling as a selling of two or more products in a package, at a special price. In this paper, we use the latter definition. Yet, due to a lack of literature consensus on a precise definition, practical implications of product bundling are still imprecise as well. Some of the basic terms that are present in literature are described below.

Bundling. Bundling is the sale of two or more separate products in one package. The term "products" refers to both goods and services. If there are separate markets, or at least some customers want to buy products separately, we can legitimate the term "separate products" (Stremersch and Tellis, 2002).

Bundling focus. There is a significant difference between product bundling and price bundling, though sometimes literature lacks clear distinction between the two. Price bundling is the offer of a package of two or more separate products at a discount. Since products are not otherwise integrated, bundling itself does not create added value. There are many examples for this, for instance: McDonald's Big Mac meal. Product bundling integrates two or more independent products at any price. This generally brings significant added value to customers, think of convergence (mobile phone and TV), convenience (cable TV, internet and landline), performance (proteins plus personal fitness plan), and reduced risk (car insurance and life insurance). It is important to differentiate price and product bundling, whereas price bundling is a pricing and promotional tool, while added value provides more strategic dimension to product bundling. Price bundling can be used on short notice, while product bundling demands long-term planning (Ulrich and Eppinger, 1995).

Bundling form. Bundling may occur in one of following forms: pure or mixed. Pure bundling offers only bundled products for sale while mixed bundling is a strategy where firms offer both the bundle and each

individual product separately. Pure bundling is preferred whereas pure bundling and mixed bundling are proportionally profitable (Hui et al., 2012).

2.2. Complementary and non-complementary bundles

In this study, we focus on functional complementarity, where bundle components are dependent or functionally related (Ahluwalia, 2008). This concept is based on a wide scope of relations between bundled products: target audience overlap, convenience and usage situation, functional similarity, timing, image, occasions, seasonality, distribution, promotion, demand (Varadarajan, 1986). Guiltinan (1987) states that the degree of product complementarity is a crucial factor to the success of bundling strategy.

Complementary bundles are those in which individual products are functionally related (Sheng et al., 2007) and can be used together as a system in order to perform certain activity (for example: hotel and rent-a-car, razor and blade). In a perfect setting, one of the products creates the need for consumption of its complement - for example, demand for cheeseburger creates parallel demand for soda, ketchup, mustard etc. It is widely accepted that level of complementarity affects and enhances consumer perception of bundle components (Meyers-Levy at al., 1994). Complementarity of the bundle can offer economies of scale, and demand for one product creates a demand for its complement. Firms can thus gain more marketing effects through bundling, and moreover, profit - since consumers are more likely to purchase both products if the price is reasonable (Yan and Bandyopadhyay, 2011).

Non-complementary bundles are composed of products that are not functionally related to one another, have weak associations and are less likely to be used in common usage situations (for example: washing machine and make-up, mobile phone and sunscreen). With lower degree of complementarity, there is asymmetrical equilibrium, and majority of consumers opt for the dominant product (in terms of brand, price or demand) while fewer consumers decide to buy both (Yan and Bandyopadhyay, 2011).

Although complementary bundle seems like a reasonable, obvious and somewhat logical choice, there is an increased number of non-complementary bundles on the market, and in the next chapters of this paper we will try to find a reason why firms are doing so.

3. RESEARCH METHODOLOGY AND RESULTS

Our study employed examples of real brands in the marketplace in order to ensure the relevancy for managerial implications. Methodology used for illustrating the practice of bundling products is a case study analysis. We employed qualitative analysis of both secondary and primary data, gathered from campaigns in which one of the authors was engaged as account director for the projects presented as a case. Campaigns refer to bundled offerings of electronics and were executed on Serbian market, from February 2014 till February 2015. We examined bundles containing pairs of products of same quality, as we identified it as natural scenario (Brito and Vasconcelos, 2014). We considered two broad groups of products: consumer electronics and personal care. Samsung was chosen as a focal brand, while Sephora, Nivea and Braun were chosen as non-complementary brands. Bundles were assembled the following way: one consumer electronics product and one personal care product, as shown in table below:

Table 1: Product bundles used in desktop research

Bundle	Focal Brand	Non-complementary brand
Washing machine and make-up	Samsung “Black lady” WM	Sephora make-up
Mobile phone and sunscreen	Samsung Galaxy S5	Nivea Sun Protect 50
Microwave and razor	Samsung MWO	Braun shaver

All three bundles were launched on the market during 2014, and to make things more interesting all three bundles were used to support product launches of respective products.

We explored communication of all three bundles using secondary data sources that include retailers’ and manufacturers’ websites, social network channels and available web archives. Furthermore, we used primary data gathered from the campaigns (web banners, social media posts, web site, OOH, leaflets, wobblers, window graphics), as one of the authors works at advertising agency Leo Burnett and was engaged as account director for the projects presented in the paper. These examples are published in consideration of both the agency and the retailers (Homecenter, Positive line) who launched the aforementioned bundles, with the acknowledgment of Samsung.

In order to prove our findings, we used what we considered the control bundle, composed of complementary products – Samsung UHD TV and Pickbox, also launched in 2014, on the same market and at the same time as non-complementary bundles that were investigated.

On the basis of theoretical background and direct author's involvement in planning and executing bundle offerings, we compared the span of target audiences and the number of communication touch points in order to identify the effects from the communication perspective. Results are given below.

3.1. Effects of bundle offerings

When the level of complementarity is high, the associations between two products are strong (Khandeparkar, 2014). Therefore, it's likely to assume that target audience will be more compact and similar in consumption. Bundles composed of complementary products tend to have significant target audience overlap (in our example, a consumer who purchases a Samsung UHD TV is more likely to have interest in a Pickbox, since both products can work as a system, and are fulfilling very similar needs, due to functional relations). With the low level of complementarity, products are addressing different and broader target audiences, with lower overlap. In the presented case, analysis showed that the lower level of complementarity between the bundle components reaches the broader target audience.

The rationale for this lies in the fact that consumer electronics products and personal care products have low degree of overlap of desired target audiences. On one side, we have consumers who are motivated to buy e.g. washing machine, while on the other side we have consumers who are not considering purchase of white goods before they are addressed with joint communication. The presence of both products works as added value for the first group (since the price of make-up is considerably lower than that of washing machine), and for the other group, interested in cosmetics, this type of bundle manages to raise awareness of non-complementary bundle component. Therefore, we have a broader target audience we are addressing, with a potential - raised awareness will create prompted interest in purchasing bundled products. If the products are complementary (UHD TV and Pickbox), this type of bundle raises interest within a homogenous target audience, with low or no potential to induce purchase intention within other target audiences.

Furthermore, from our experience, the lower level of complementarity of bundle components provides more communication touch points. This proposition indicates that bundling of non-complementary products has a considerable effect on the number of communication touch points. Let's examine a bundle composed of a Samsung washing machine and a piece of Sephora make-up. In this example we have joint communication channels, such as mass media (OOH, print, web, TV), social network channels (Samsung, Sephora and Homecenter respectively), retail (Homecenter). When comparing it to a bundle consisting of complementary products (Samsung UHD TV and Pickbox), we noticed that that number of communication channels was lower, since Homecenter is a retailer of both Samsung and Pickbox, due to the similar product categorization. This is a potential task for further examination: what is happening if products of same category, but with low level of complementarity are sold in bundle by different retailers? For example, supermarkets have a broad scope of product categories, and this type of bundle is more likely to happen in such retail environment.

4. CONCLUSION AND MANAGERIAL IMPLICATIONS

Previous researches investigated bundles from different perspectives. Determining which products should be bundled in order to maximize communication effect is a challenging issue when deciding about bundling strategy. In this paper we analyzed examples of bundles composed of a pair of otherwise unrelated, non-complementary products, and identified that they can serve as important communication tool that could provide a broader target audience and - under certain circumstances - engage more communication channels. Our findings indicate that firms should join in bundle arrangements of unrelated products if and when they want to penetrate into secondary target groups and decrease the level of advertising investment.

There are several limitations to our research: it was conducted specifically for consumer electronics products combined with personal care products with a specific retailer. Further research should explore a more complete information setting, at least more different industries and bundled products.

A manager can use our insights in order to decide on an optimal bundling strategy. If their major goal is to maximize profit, they can combine highly complementary products and charge them at a relatively lower price (Yan and Bandyopadhyay, 2011); or if they are undertaking activities that affect market size in terms of broadening the scope of target audiences, they can combine non-complementary bundles in partnership with unrelated companies from different industries.

REFERENCES

Ahluwalia, R. (2008). How far can a brand stretch? Understanding the role of self-construal. *Journal of Marketing Research*, 45, 337–350.

Armstrong, M. (2012). A more general theory of commodity bundling. *Journal of Economic Theory*, 148: 448–472.

Brito, D., & Vasconcelos, H. (2014). Bundled discounts: Strategic substitutes or complements? *Economics Letters*, 124(2), 278-282.

Brito, D., & Vasconcelos, H. (2015). Interfirm Bundling and Vertical Product Differentiation. *Scandinavian Journal of Economics*, 117(1), 1-27.

Estelami, H. (1999). The computational effect of price endings in multi-dimensional price advertising. *Journal of Product & Brand Management*, 8(3), 244-256.

Gans, J., & King, S. (2006). Paying for loyalty: Product bundling in oligopoly. *Journal of Industrial Economics*, 54(1), 43-62.

Girju, M., Prasad, A., & Ratchford, B. T. (2013). Pure components versus pure bundling in a marketing channel. *Journal of Retailing*, 89(4), 423-437.

Guiltinan, J.P. (1987). The price bundling of services: a normative framework. *Journal of Marketing*, 51, 74–85.

Harlam, B., Krishna, A., Lehmann, D., & Mela, C. (1995). Impact of bundle type, price framing and familiarity on purchase intention for the bundle. *Journal of Business Research*, 33, 57-66.

Khandeparkar, K. (2014). The role of complementarity and partner brand price level in new product introduction strategy using bundle offers: A study on the quality perception of bundle components. *Journal of Retailing and Consumer Services*, 21(6), 992-1000.

Meyers-Levy, J., Louie, T.A., & Curren, M.T. (1994). How does the congruity of brand names affect evaluations of brand name extensions. Journal of Applied Psychology, 79(1), 46-53.

McCardle, K., Rajaram, K., & Tang, C. (2007). Bundling retail products: models and analysis. *European Journal of Operational Research*, 177(2), 1197-1217.

Mialon, S. H. (2014). Product bundling and incentives for mergers and strategic alliances. *Economic Inquiry*, 52(2), 562-575.

Sheikhzadeh, M. & Elahi, E. (2013). Product bundling: Impacts of product heterogeneity and risk considerations. *International Journal of Production Economics*, 144(1), 209-222.

Sheng, S., Parker, A.M., & Nakamoto, K. (2007). The effects of price discount and product complementarity on consumer evaluations of bundle components. Journal of Marketing Theory and Practice, 15 (1), 53–64.

Sheng, S., & Pan, Y. (2009). Bundling as a new product introduction strategy: The role of brand image and bundle features. *Journal of Retailing and Consumer Services*, 16(5), 367-376.

Simonin, B., & Ruth J. (1995). Bundling as a strategy for new product introduction: Effects on consumers' reservation prices for the bundle, the new product, and its tie-in. *Journal of Business Research*, 3(3), 219-230.

Stremersch, S., & Tellis G. J. (2012). Strategic bundling of products and prices: A new synthesis for marketing. *Journal of Marketing*, 66, 55-72.

Ulrich, K. T., & Eppinger, S. D. (1995). *Product Design and Development*. New York: McGraw-Hill

Varadarajan, P. R. (1986). Horizontal cooperative sales promotion: a framework for classification and additional perspective. *Journal of Marketing*, 50, 61-73.

Yan, R., & Bandyopadhyay, S. (2011). The profit benefits of bundle pricing of complementary products. *Journal of Retailing and Consumer Services*, 18(4), 355-361.

Yan, R., Myers, C., Wang, J., & Ghose, S. (2014). Bundling products to success: The influence of complementarity and advertising. *Journal of Retailing and Consumer Services*, 21(1), 48-53.

CORPORATE RESTRUCTURING **152**

DMS AS A PROACTIVE APPROACH IN RESPONSIBLE RESTRUCTURING **153**
Stanojević Terzić Slobodanka

MODEL FOR RESTRUCTURING PUBLIC PROCUREMENT SYSTEM IN SERBIA **160**
Todorović Ivan, Komazec Stefan, Jaško Ondrej

PUBLIC PROCUREMENT CENTRALIZATION – FUNCTIONS OF THE CENTRAL BODY FOR PUBLIC PROCUREMENTS **170**
Komazec Stefan, Todorović Ivan, Jevtić Miloš

CORPORATE RESTRUCTURING

DMS AS A PROACTIVE APPROACH IN RESPONSIBLE RESTRUCTURING

Slobodanka Stanojević Terzić
University of Belgrade, Faculty of Organizational Sciences
e-mail: bobanas@gmail.com

Abstract: *The world economy has been and will be seeing a great number of corporate restructuring due to the environmental changes which require radical actions. This research has been guided by the idea of analysing manners in which a responsible operational restructuring could be achieved by emphasizing standardization, reliability and flexibility. DMS directs a company towards a disciplined approach, shaping operational restructuring as a proactive process, while supplying decision makers with relevant and accurate information necessary for making a call for significant changes in processes and responsible elimination of excess capacity.*

Keywords*: DMS, operational restructuring, proactive approach, responsible restructuring*

1. INTRODUCTION

Corporate restructuring is usually the most common logical step when a company faces some serious difficulties in keeping its position on the market. The first association with corporate restructuring is a severe type of crisis which results in distress and bankruptcy. Such crisis is then correspondingly solved by merger or acquisition or takeover. However, corporate restructuring is also applicable as reasonable means for keeping pace with changing environment when company faces constant underperformance for a remarkable period of time, failing to remain as competitive. And the environmental changes are grand, frequent, and very often unpredictable. If a company could know what was coming ahead it would have planned its optimal moves and the impact of the environment would be directly related to the company's level of proficiency.

According to Pomerleano and Shaw (2005), ~~-~~addressing [corporate restructuring] problem requires the complementary efforts of policymakers, regulators, lawyers, insolvency experts, corporate restructuring specialists, and financiers" (p. 436). Pomerleano and Shaw are making that statement in relation to severe corporate crisis. It is an utmost complex and painful process. Up until that point, a company should act on the very first signs of decline and take necessary actions in operational restructuring towards achieving overall business improvement and avoiding the distress scenario. Since redesigning business processes implies strategic actions, which ~~-~~require consistency between the company's business strategy and vision" which further ~~-~~require understanding the company's strengths and weaknesses, and the market structure and opportunities", it indirectly provides grounds for well driven and detailed analysis and insight into the existing conditions (Attaran, 2004, p. 7). Process based restructuring helps in identifying critical business activities, providing flexible distribution of accountability and responsibility, thus affecting organizational performance.

Burchell (2011) adduces that Information Technology (IT) is involved in any major organizational change; be it a major business process re-engineering project or a merger or acquisition, in order to consolidate the system(s), current IT infrastructure must be evaluated (p. 20). It gives insight into current portions of work. ~~-~~In this case, because many major change initiatives can occur in stages, the IT portion of the merger may be treated as its own IT change project occurring after the physical merger has been completed" (p. 20).

Standardization, in general, helps to ease existing disturbance present in different segments of the company dealing with the same set of data or activities. While improving quality and predictability of business deliverables, it also reduces cost and boosts efficiency. It further helps defining a unique routine when it comes to evaluating cross-organizational portions of business, thus providing means for defining and generating appropriate indicators which will be used for analysis and decision making when it comes to building the operational restructuring strategy.

While standardization helps setting relevant and uniform base for work, pursuing thoughtful process management will improve optimization, collaboration and harmonize overall efforts. According to Becker et al

(2013), unstructured processes are difficult to be adopted due to the fact that there is no control of the side effects, further stating that ~~c~~learly structured processes show interdependencies with other processes and can therefore be changed in partial sections without losing the overall context" (p. 7).

As Attaran (2004) suggests, the most effective enabling technology for Businesses Process Reengineering (BPR) is Information Technology, which is present through the phases ~~b~~before the process is designed, while the process design is underway, and after the design is complete" (p. 7), helping in meeting the objectives of reengineering in three ways: ~~B~~By providing information across functional levels and establishing easy communication, improving the process performance and finally by helping the reengineering effort by modeling, optimizing and assessing its consequences." (p. 21).

The usefulness of Document Management System (DMS) in companies is multifaceted. This paper will address how DMS could help in analysis and valuation process aiming at finding the optimal operational restructuring strategy, as well as support its implementation. It also gives a brief overview of some restructuring approaches in recent practice, and further discusses the importance of flexibility of the system needed for addressing the issue with respected company's specifics. The aim of the paper is to provide an overview of key DMS aspects and how they influence restructuring process.

Assumptions on which this discussion is based on are that DMS is being implemented according to results of a well driven analysis, thus structured and customized in a way that it reflects the true state of the needs and the work at the company. Furthermore, the term of DMS concept is used in its general and most comprehensive form; the term corporate restructuring is mainly referring to organizational restructuring as a strategy to respond to both decline and new opportunities.

2. A COMPREHENSIVE DMS CONCEPT

The term and functionality of DMS is inconsistent both in literature and in practice. As stated in ISO/TR 22957:2009, ~~T~~erms and acronyms associated with various aspects of EDMS technologies commonly change over time, as technology developers and vendors update product lines and solutions to address customer requirements." Due to that fact, the concept of DMS has evolved and judging by certain customized implementations can be said to have most of the functionalities commonly related to Content Management Systems (CMS), Electronic Records Management Systems (ERMS), Business Process Management (BPM) and Enterprise Report Management (ERM).

Each of the various segments of such comprehensively defined DMS supply the company, in different proportions albeit jointly, with an expedient manner for defining, changing, controlling and improving the overall performance of the company.

3. TAKING A LOOK AT THE FIELD OF PRACTICE

In practice, companies have been orchestrating and pulling off some major restructuring plans. With big corporations in question, they have almost by the rule been oriented towards both operational and financial restructuring.

Some of most recent examples include Advanced Micro Devices, Inc. (AMD), an American multinational company, which has in the third quarter of 2015 implemented a restructuring plan with focus on simplifying the business and aligning resources. Some of the action steps included a workforce reduction of approximately 5% and outsourcing certain IT services and application development. While taking their actions they were, at the same time, aware of the fact that restructuring actions could have an impact on decreases in employee morale and possibility of failing to meet operational targets due to the loss of employees (AMD Annual Report 2015, 2016, p. 22). However, while being aware of the risks, along with realized ~~o~~operational savings, primarily in operating expenses, of approximately $8 million in 2015", they ~~e~~xpect the 2015 Restructuring Plan to result in operational savings, primarily in operating expenses, of approximately $48 million in 2016" (AMD Annual Report 2015, 2016, p. 42). [Note: forward looking statement.]

Another example is Samsung, a South Korean multinational conglomerate company, which along with its annual reorganization (Samsung Press Release, 2015), has decreased its workforce and cut down research and development investment. The most recent restructuring plan that significantly reduces the number of employees belongs to Intel Corporation, an American multinational company, reducing global workforce by up to 12,000 jobs, which is approximately 11 percent of employees (Intel Corporation News Release, 2016). The restructuring initiative aims ~~t~~o accelerate its evolution from a PC company to one

that powers the cloud and billions of smart, connected computing devices." Aside from improving efficiency, Intel plans to increase investments in the products and technologies.

On the other hand, a Japanese conglomerate company Sony, striving to reinforce competitiveness and enhance effectiveness and efficiency, is undergoing splitting out of business as well as realigning their platform functions that support each of its business units (Sony Corporation Press Release, 2016). In conjunction with this structural realignment, where the responsibilities are transferred from Sony Group to its affiliates, additional changes are to be made to Sony's executive assignments ~~-in~~ order to further clarify lines of responsibility and assignments within each business and the headquarters organization" (Sony Corporation Press Release, 2016). The number of ranks in the organization is cut from eight to six, thus fostering better communication with upper management.

One of the most magnificent examples, if not the most magnificent one, is the corporate restructuring that has taken place at the Renault-Nissan Alliance. Resulting in best performance makes it a finest example of sustainable entrepreneurship in practice, in the related industry. As stated in Hughes et al (2003) case study, back in the 90's, Nissan's problems were summed by having too many plants, too many car platforms, too many suppliers and too many dealers in Japan (p. 2).

Today, the Renault-Nissan Alliance is boosting efficiency and revenue by strengthening synergies in four core divisions and launching new convergence projects, where ~~—c~~nvergence includes integrating divisions, creating common processes, exchanging talent and other significant sharing of resources", also stating that ~~-c~~onvergence helped Renault and Nissan generate more than €4 billion in annualized synergies in calendar year 2015" (Renault-Nissan Alliance Press Release, 2016). As an example of a company not being in crisis nowadays but rather following an evident need for keeping pace with the changing environment, their restructuring is a remarkable state-of-art in taking a proactive approach in accordance with the fact that ~~-g~~lobalization is happening; no matter you want it or not, if you think there's a risk or not, you need to play by it" (Ghosn, 2016).

In other practices, some companies are experimenting with different approaches, be them referred to as reorganization, restructuring or different.

An American company Amazon.com, Inc. (Amazon) decided to have three CEO's – CEO of the entire company, CEO of Worldwide Consumer and CEO of Amazon Web Services, ~~-n~~ot as a reorganization but rather a recognition of the roles they've played for a while" (Amazon.com, Inc. Press Release, 2016). Another American company, Google Inc, created a parent company, actually restructured to a new holding company Alphabet Inc. with Google being its largest subsidiary (Alphabet Inc. Certificate of incorporation, 2015).

Lin et al (2006) point out that ~~-r~~estructuring plans take many forms, such exiting a line of business, closing or relocating a facility; though can be a broad company-wide reorganization that impinges upon nature and focus of operations.", following with emphasizing that ~~-d~~difficult decisions must be made" that ~~-c~~an affect business strategies, operations, organizational functions and existing management structures" (p. 655).

4. HOW CAN DMS ASSIST

Holmstrom (1999) observes, discussing operational restructuring of more than half of all Fortune 500 firms that has taken place in 80's and 90's in the US, that they have had a focus on their core competencies (p. 408-409). Those concurrently reflect both internal and external triggered issues, i.e. the ones coming from over stuffing or under stuffing, inconsistent and inefficient communication, outdated technology or work procedures, inadequate performance indicators, loosely defined accountability for outputs, poor management, as well as lack of compliance regarding existing market needs, underdeveloped and unaffordable outputs, poorly managed partners' and suppliers' relationships, and others. DMS could assist in identify roots of company decline, and visualize some of the actions to be taken towards regaining its strength.

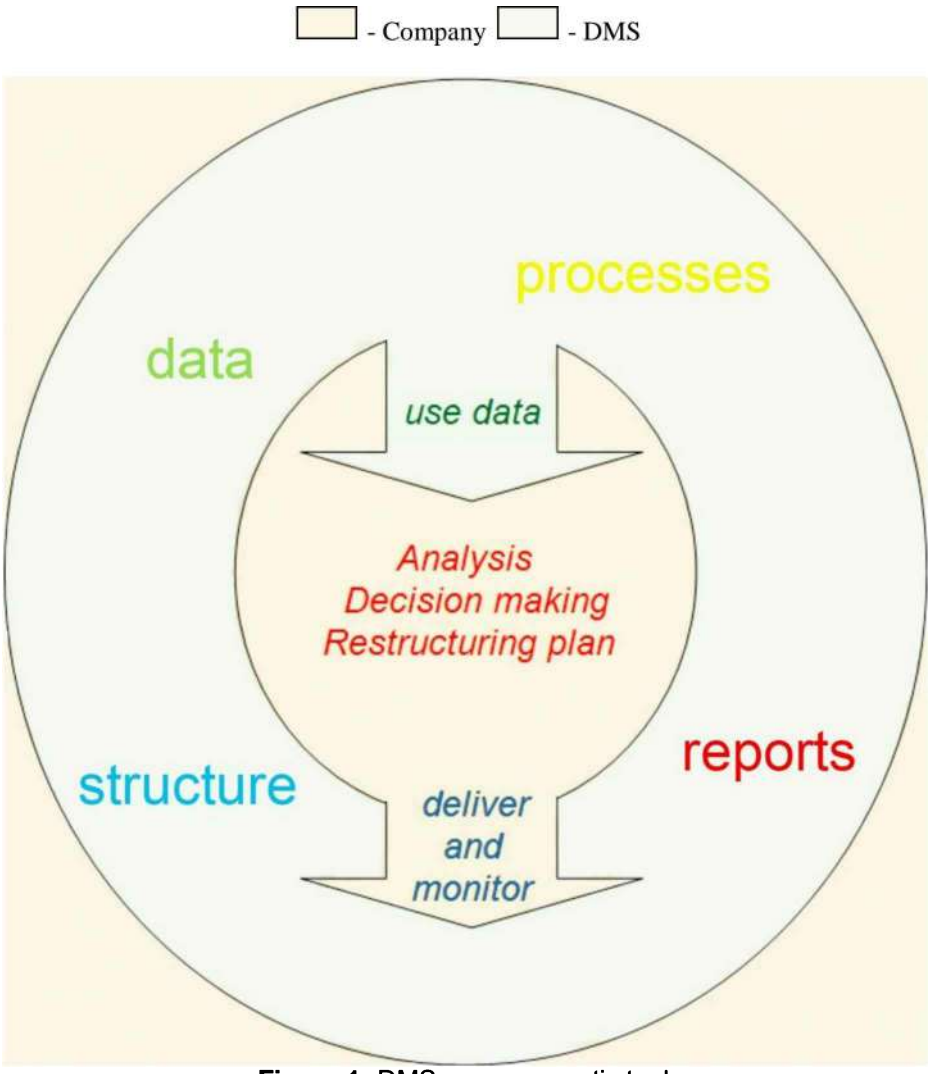


Figure 1: DMS as a pragmatic tool

4.1 The importance of analysis and valuation

It is a great challenge when it comes to valuing declining companies. According to Ruiz (2014), regarding traditional valuation methods in companies in decline and distress, their applicability is limited due to the fact that the fundamental assumptions of these methods are violated by the characteristics of these companies, consequently leading practitioners to incorporate new approach —based primarily on personal assessments to value distressed securities" (p. 6). The use of personal judgment and new paradigms instead of the traditional theoretical approach resulted in high variation in the estimates (Damodaran, 2009).

For a company, in order to define guidelines for future actions, it is necessary to find an adequate series of methods for capturing possible causes of underperformance as well as to conduct a valuation of the company, and finally architect a restructuring plan. There are no universal methods that would deliver a finest precision in all scenarios of underperforming companies. Practitioners are guided by traditional methods supporting them with personal approach addressing each individual company in accordance with its specifics.

If a company is facing a decline, it should be put through the analysis to find the possible reasons for it. The company's performance is to be evaluated and it is to be estimated whether the decline is reversible or not, and hence the relevant issues should be addressed. One of the assisting tools for that kind of analysis is DMS which supplements managerial efforts in identifying key business areas which are underperforming and consequently listed for cut-off, as well as those prosperous enough but needing adjustments in order to provide expected level of performance. It enables a company to spot emerging sections of work and to accelerate decision making process.

4.2 Tracking the cause

After having in depth analysis and evaluation, it is of great importance to the analysts to track the cause for the decline in performance. It is one of the prerequisites in regaining the stability and achieving velocity, and eventually ultimately accomplishing a firm management of change in velocity. It is not only about gaining the speed, the direction matters as much, if not more. While evaluating various elements in search for possible causes for the corporate decline, analysts will determine a range of those that are to be tracked within the business and work processes, as well as those related to the environment, such as strengthening of a competitor or shift in consumer preference. Each of the factors related to the environment should be reviewed and a judgment should be made on the persistence of designated changes. With a clear vision of the framework that the company was to work within, the fields and scope of the flexibility that it was to deliver, a list of actions is to be presented which will make grounds for restructuring plan.

Performance evaluation is lead by taking a closer look at the outputs of the business processes. A detailed analysis of relevant outputs throughout a certain period is taken into account along with relevant conditions that influenced and accompanied them. What gives an extra perspective is analyzing those processes in depth, with their corresponding activities and the employees conducting them, which can be retrieved from DMS data. Such analysis would result in possible work spots that underperformed, leading to a set of required actions based on that finding. Another perspective that could be looked from is cross engaging relevant responding managers who were business process owners at the time of each of the periods analyzed. All of these analytical actions based on the information that could be found in DMS could result in a conclusion that the company decline is a reversible one while pointing out the specific causes and issues requiring adjustments.

4.3 Communication and collaboration

By its definition and one of the key functionalities, DMS helps in relaxing congested communication channels, implementing clearly attributable and transparent communication, and finally setting clearly attributable accountability and responsibility.

The core values of the processes are imposed through its structure and algorithm, boosting efficiency by optimal collaboration practices. DMS also assists in introducing new business processes added as a result of restructuring, in a smooth way. It further helps managing diversity of business processes setting the ground for it in the main DMS structure, allowing adjustments that would affect all or some processes previously implemented.

Guided by the nature and the extent of projected business processes, it eases delivering an adequate training for existing or new employees. It is by far much easier to develop and realize a successful training with known and acceptance-proved tailored methods, previously defined and performed for earlier similar processes.

4.4 The importance of clear and reliable information

As Peter F. Drucker observed in his famous quote: „Whenever you see a successful business, someone once made a courageous decision". It takes clear, reliable and accurate information to make such kind of decision. Finally, it takes well captured and flexibly implemented IT infrastructure to successfully deliver it.

Quality of the information is primarily based on the quality of the data within DMS. However, having an accurate and relevant set of data is not enough, it has to be classified and categorized in a useful manner. Furthermore, it is important to have the information presented in a useful form.

Quality of data within DMS is imposed by various aspects of implementation of the system. Predefined input formats are set whenever possible, mandatory entry rules defined at all levels of processes, data set available for input or edit only to the desired work spots or employees, necessary logical entry or forward/pass item checks are implemented throughout the system, and others. There are numerous implementation instruments insuring best quality of data possible.

With the quality being assured, information is put in a series of synthetic forms, supplying decision makers with a spectrum of needed views.

4.5 Reporting and decision making

Having daily reliable reports allows the company to be able to exercise better control over monitoring and decision making in face of the volume of both the employee and the process diversity.

Aside from various predefined reports, custom-made ones are designed to address a specific business need. Furthermore, the whole set of information can be additionally empowered by integrating DMS data with other available system.

After perceiving all business processes, it is to be decided which ones will be discontinued, which are to be intensified, which are to be modified, what new processes are to be introduced. It is very common for a corporate restructuring plan to involve a significant headcount cut. Based on the results of the analysis it is crucial to make reasonable projections concerning optimal employee selection, both in number and reliable required knowledge and skills.

It is of great importance for decision makers to find the optimal set of operational restructuring actions as not to unsettle current business. What triggers the distortion of business processes does not necessarily have to be the volume of operational restructuring actions but rather their incompatibility and unbalanced range. Thus a cyclic and continuous observance of different aspects of business using different relevant reports is necessary, this making DMS a pragmatic business tool.

Deploying in accordance with previous discussion enables company to develop better performance management system, adequately accessing lagging indicators thus assessing important key factors and developing new leading indicators.

5. CONCLUSION

DMS can assist a company in a major part of restructuring process, from detecting a need for a radical change, conducting the analysis and tracking the critical issues, providing information needed for decision making and designing a restructuring plan, providing a business IT infrastructure in which to implement the changes while having employees work within the known system, providing grounds for designing and generating suitable reports which will enable continuous monitor over the realization of the process.

Back in 1877, Leo Tolstoy observed that ~~h~~happy families are all alike; each unhappy family is unhappy in its own way". That applies to companies as well which is why each company needs to have its own tailor made approach when it comes to restructuring. There is no unique kind of approach that would suit every possible scenario, not even within a single company let alone having a global market in mind. By using DMS, a company achieves a great level of flexibility in redesigning business process structure, as well as in strong communication and collaboration capabilities throughout the restructuring process.

Moreover, while supporting the implementation of operational restructuring it is providing means for designing a sustainable concept of continuous improvement. No matter how grand and well conducted the change is, their effects are not everlasting and the company remains sensitive to environmental changes, thus a continuous improvement is forced upon.

REFERENCES

Advanced Micro Devices, Inc. (2016). 2015 Annual Report on Form 10-K [PDF file]. Retrieved April 20, 2016, from: http://ir.amd.com/phoenix.zhtml?c=74093&p=irol-reportsannual.

Alphabet Inc., Certificate of incorporation (2015). Retrieved April 20, 2016, from: https://abc.xyz/investor/other/certificate-of-incorporation.html.

Amazon.com, Inc. Press Release, Kudos (2016). Retrieved April 19, 2016, from: https://www.amazon.com/p/feature/ch9nzgzhrjh59ty?ref_=aa_navt_3&pf_rd_r=8526RRABZHGMAXB9HQ37&pf_rd_p=74a13dd0-74de-4a33-a353-821dde9bc330#Kudos&tag=bisafetynet-20.

Attaran, M. (2004). Exploring the relationship between information technology and business process reengineering. *Information & Management*, *41*(5), 585-596.

Becker, J., Kugeler, M., & Rosemann, M. (Eds.). (2013). *Process management: a guide for the design of business processes.* Springer Science & Business Media.

Burchell, J. (2011). Anticipating and managing resistance in organizational information technology (IT) Change initiatives, *International Journal of the Academic Business World*, 5(1).

Damodaran, A. (2009). *The Dark Side of Valuation: Valuing Young, Distressed, and Complex Businesses*, FT Press.

Ghosn, C. (2016). speech presented at Renault-Nissan Alliance media roundtable for international journalists at the 2016 Detroit Motor Show. Retrieved April 18, 2016, from http://nissannews.com/en-US/nissan/usa/channels/Renault-Nissan-Alliance-News/releases/carlos-ghosn-hosts-a-q-a-with-media-at-the-2016-naias.

Holmstrom, B. (1999). Future of cooperatives: A corporate perspective. *Liiketaloudellinen aikakauskirja*, 404-417.

Hughes, K., Barsoux, J.L., & Manzoni, J.F. (2003). *Redesigning Nissan (A): Carlos Ghosn Takes Charge* [PDF file], INSEAD, Fontainebleau, France. Retrieved from: http://www.massmed.org/Continuing-Education-and-Events/Conference-Proceeding-Archive/Leaders--Redesigning-Nissan-(A)-(pdf)/.

Intel Corporation News Release (2016). Intel Announces Restructuring Initiative to Accelerate Transformation. Retrieved April 20, 2016, from: https://newsroom.intel.com/news-releases/news-release-intel-announces-restructuring/.

ISO/TR (2009). *ISO International Standard* ISO/TR 22957:2009(en): Document management — Analysis, selection and implementation of electronic document management systems (EDMS), Geneva, Switzerland: International Organization for Standardization (ISO). Retrieved March 12, 2016, from: https://www.iso.org/obp/ui/#iso:std:iso:tr:22957:ed-1:v1:en.

Lin, B., Lee, Z. H., & Peterson, R. (2006). An analytical approach for making management decisions concerning corporate restructuring. *Managerial and Decision Economics*, 27(8), 655-666.

Pomerleano, M. & Shaw, W. (2005). *Corporate Restructuring: Lessons from Experience*. Washington, DC: World Bank. © World Bank. https://openknowledge.worldbank.org/handle/10986/7373 License: CC BY 3.0 IGO.

Renault-Nissan Alliance Press Release (2016). Renault and Nissan strengthen convergence to boost efficiency and revenue. Retrieved April 18, 2016, from: http://nissannews.com/en-US/nissan/usa/channels/Renault-Nissan-Alliance-News/releases/renault-and-nissan-strengthen-convergence-to-boost-efficiency-and-revenue.

Ruiz, S.A., (2014). On the Valuation of distressed firms (Master thesis, Copenhagen Business School, Copenhagen, Denmark). Retrieved April 18, 2016, from: http://studenttheses.cbs.dk/bitstream/handle/10417/4864/sebastian_afflerbach_ruiz.pdf?sequence=1. 6

Samsung Press Release (2015). Samsung Electronics Announces Annual Reorganization for 2016. Retrieved April 18, 2016, from: http://news.samsung.com/global/samsung-electronics-announces-annual-reorganization-for-2016.

Sony Corporation Press Release (2016). Sony Corporation announces changes to organizational and management structure. Retrieved April 19, 2016, from: http://www.sony.net/SonyInfo/News/Press/201603/16-028E/index.html.

MODEL FOR RESTRUCTURING PUBLIC PROCUREMENT SYSTEM IN SERBIA

Ivan Todorović*[1], Stefan Komazec[1], Ondrej Jaško[1]
[1]Faculty of Organizational Sciences, University of Belgrade
*Corresponding author, e-mail: ivan.todorovic@fon.bg.ac.rs

Abstract: *Models for organizing public procurement systems tend to find the compromise between the efficiency and the control of budgetary funds utilization. Centralization of public procurements at local level can provide significant benefits for local self-governments. It is present at certain form in almost all EU countries. However, users of local budgetary funds in Serbia perform completely independently, which causes irrational behavior and financial losses. Belgrade is the only local self-government where the body for centralized procurements was formed. This paper provides the model for restructuring public procurement system in Serbia by introducing centralization of public procurement at local level, considering the existing organizational models of local administrations and their current capacities.*

Keywords*: public procurement, restructuring, centralization, local self-government, public administration, organizational structure, body for centralized procurement*

1. INTRODUCTION

One aspect in the centralization of public administration is the centralization of public procurements (Brezovnik & Oplotnik, 2015). It considers the introduction of the Central Purchasing Body at the level of local self-government. Such entity either acquires works, goods and services for the needs of one or more purchasers from the public sector, or concludes the contracts for the works, goods and services for the needs of one or more purchasers from the public sector, or concludes the framework agreements for works, goods and services for the needs of one or more purchasers from the public sector (European Union No. 2004/18/EC). Besides this, Central Purchasing Body should also have advisory and control functions. Public procurements have a very major impact on public finance and the budgets of local self-governments (Jansen, 2012). Their centralization can provide significant benefits, especially in terms of financial savings, due to economy of scale, and increased control, because of decreased number of individual procurements. However, it is important to find the ballance between the efficiency and control (Pegnato, 2003), since the centralization at local level complicates the procurement process and carries certain risks (Dimitri, Piga & Spagnolo, 2006; Albano & Spar, 2010). The purpose of this paper is to determine the capacities of local self-governments for performing the functions of the body for centralized procurements and to propose the model for centralizing public procurements at local level in Serbia, which is applicable considering existing organizational models and current process flow.

At present, in Serbia there are more than 12,000 purchasers obliged to apply the Law on Public Procurements (2015). According to the Standing Conference of Towns and Municipalities (SCTM) data they are territorially arranged in 168 local self-government units (excluding Kosovo) or 197 local self-governments including Kosovo (Mapping municipalities, SCTM). The largest number of purchasers conduct public procurement procedures independently. The city of Belgrade is the only local self-government in Serbia which formed the body for centralized procurements. The service for the centralized public procurements and control of procurements is an independent and autonomous organizational unit and for its work reports directly to the mayor (Official Gazette of the City of Belgrade, 2014). This raises the question of their ability to appropriately and at the best conditions procure the necessary goods and services. This is primarily related to personnel, organizational and technical capacities of the local self-governments to implement public procurement procedures in full compliance with the Law on Public Procurements (2015), and in accordance with EU directives (Arrowsmith, 2009). Findings related to these issues will be presented in paragraph three, after the methodology description in second part. Fourth section will provide the proposal of the model for centralizing public procurements at local level in Serbia, while final chapter will point out the conclusions and directions for further research.

2. METHODOLOGY

The findings presented in this article were generated during the United Nations Development Programme (UNDP) project performed by the authors during the year 2015. Analysis of EU directives and relevant literature provided the theoretical background and framework for the proposed centralization model. The capacities of local self-governments in Serbia for performing the functions of the body for centralized procurements were determined using the questionnaire that was created for this purpose, while certain conclusions were extracted from the interviews with the representatives of SCTM and Public Procurement Office. Proposed model was based on research results and authors' previous expertise in the field of organizational design and restructuring.

3. CAPACITIES OF LOCAL SELF-GOVERNMENTS IN SERBIA FOR PERFORMING THE FUNCTIONS OF THE CENTRAL BODY

3.1. Human resource capacities

The results showed that personnel capacities represent one of the main problems in local self-governments for the implementation of the Law on Public Procurements (2015). As without adequate personnel capacities, it is impossible to ensure transparent and efficient public procurements (Sakane, 2009), a special attention should be given to this issue. Based on the conducted research, it is possible to draw certain conclusions about the human capacities of the local self-governments in the area of public procurements.

Unlike the results of similar research conducted immediately after the introduction of the new Law on Public Procurements in 2012, which was organized by the Standing Conference of Towns and Municipalities (SCTM), where one of the main identified problems was the lack of public procurement officers (Komazec, Todorović, Krivokapić & Jaško, 2013), the situation in this segment is significantly better today. Current situation regarding the number of certified officers for the public procurements in the analyzed municipalities has drastically improved. Although there are still cases of municipalities where certified procurement officers are working on the jobs have no even indirect connection with public procurements, such examples are rare, and in all those municipalities more than 50% of employees on public procurement jobs have the status of certified officers for public procurements, while in some local self-governments that percentage exceeds 80%. This fact demonstrates the strengthening of the capacities of local self-governments for planning and implementing public procurement procedures.

At the same time, a part of this research was related to the workload of employees engaged on public procurement jobs. Data on the number of public procurement procedures and contract values were analyzed for the previous three years, in order to determine the trend and eliminate any variation in the number or value and determine realistic, expected number of procedures on the level of one year. Since such variations were not determined, number of procedures and contract values referred to the year 2015 were used for the analysis. Differences in the workload of employees on public procurement jobs per various local self-governments, expressed in a number of procedures that they carry out during a year, are very visible, so the number of procedures per employee varies from 6 to 26, which indicates the overload of employees in some municipalities, or underutilized human capacities in others. Also, it is important to emphasize that in almost 100% of cases the type of procedure was either the open procedure or the procedure for the public procurement of small value, which indicates that the opinions of employees that they are able to conduct all types of procedures should be accepted with the reserve.

Another parameter that needs to be considered in terms of workload is the total contract value per employee on public procurement jobs. In 2015 it was ranged from 13,843,054 RSD (around 115,000 €) to 89,081,492 RSD (around 740,000 €). By comparing this data, the differences in the public procurement structures can easily be spotted. Namely, it is evident that in the local self-governments where there is relatively similar workload of employees in term of number of procedures, drastic differences in the value of public procurements per employee can be identified, which can lead to the conclusion that some of the local self-governments are better prepared for the public procurements centralization, having in mind that the employees on public procurement in those municipalities implement the procedures of higher values.

By observing the future public procurements centralization, control of public procurements was identified as a critical part of the public procurement process, in term of personnel capacities for conducting it properly. The subject of the analysis was the control of local self-governments regarding the implementation of public procurements in the institutions that are budget beneficiaries within the territory of local self-government. While in some local self-governments certain scope of control is done, in most of them such control is not

performed at all. However, the problem increases when we look at the answers on the question: "Do you think that you have personnel and technical capacities for the implementation of the public procurements CONTROL on the territory of your local self-government? Why?" More than 80% of the municipalities responded that they do not have personnel capacities for the proper implementation of control activities. Even in some of the municipalities where the control is carried out, above mentioned problem with personnel capacities refers to the fact that such control is performed by the employees who have no experience in the public procurement realization. Based on these observations, it is clear that during the public procurements centralization special attention must be paid to the development of control function. The development of the body for centralized procurements should include a gradual increase of the control function, especially in term of control objects and phases of a process that are controlled.

Finally, we also examined the situation in local self-governments related to education and advisory. First of all, it was necessary to study the existing need for education and advisory at the local level, and later the current situation in that area. On the question "How often do the budget users address with the requirements related to the public procurements (opinions, advices etc.)?" employees from 3 of 5 analyzed local self-governments responded with "very often", which confirms a clear need for constant advisory to budget users in the field of public procurements, or the necessity to develop the advisory function in the body for central procurements at local level. It can be assumed that the need for the education of budget users is also present, in order to decrease advisory requests over time. At the same time, despite the continual need for advisory, in only two municipalities were organized trainings from the field of public procurements for budget beneficiaries (by local self-government employees), and only twice in past three years. Local self-governments must find a way to provide education and advisory to employees on public procurement jobs at public sector entities which are based on their territory, since they are not often able to attend seminars from this field. In daily work they do not meet new challenges, but perform mostly routine procedures, which are repeated from year to year. For this reason they do not have the opportunity to develop themselves within the workplace.

Based on the foregoing, it is clear that in case of public procurements centralization local self-governments are currently best qualified for the function of planning and implementing the procedures, and the level of this function can be satisfactory from the very beginning of the centralization process. On the other hand, the further institutional development of the body for central procurements at the level of local self-government should be followed by the appropriate development of advisory and in particular of control function, which requires hiring additional employees and development of existing ones through specialized training.

3.2. Organizational capacities

Since public procurements, of all the activities carried out by public entities, are the most vulnerable to corruption (European Parliament - Directorate General for Research, 1998), a special attention should be paid to the control of planning, implementation and realization of public procurement procedures. The EU directives related to the public procurements contribute to the fight against corruption through two sets of measures. First, through its very nature, or through a legal framework, and second, specifically through promoting fairness among the entities that appear in a public procurement process (Bovis, 2006).

Based on research results, it is evident that only in Belgrade and Kragujevac can be identified separate organizational units for the control of planning, implementation and realization of public procurements. However, in the municipalities where there are no such organizational units, neither the employees who are assigned on these activities exclusively cannot be identified, although in larger municipalities number of employees on public procurement jobs leaves the possibility for introducing such position. The largest problem related to the jurisdiction over the control of planning, implementation and realization of public procurement procedures, in general, appears in smaller municipalities where there is no separate organizational unit for public procurements. In such municipalities it is not clearly defined who is responsible for the control, or in other words, which employees among the other tasks controls the planning, implementation and realization of public procurements. In larger local self-governments, head of the organizational unit for public procurements carries out the control activities. Due to extremely high level and extent of corruption in the Republic of Serbia, comparing to the EU member states (Transparency International, 2012), and because of the highlighted importance of the fight against corruption in the EU directives, local self-governments in Serbia should pay particular attention to the public procurements control and find adequate organizational solutions for solving identified problems in this field. They should strive for the separation of planning and implementation from the control of public procurement procedures, in several ways. Smaller municipalities, where the scope and number of public procurements does not allow organizational separation and the establishment of an independent organizational unit only for control of planning, implementation and realization of public procurements, should form a special position with

responsibilities related exclusively to the control. Regardless the model of public procurement centralization, with or without the establishment of the central body for procurements at the local level, this principle of separating organizational units or workplaces for control activities should be applied.

Within the organizational capacities, special attention should be paid to the proven capacities of certain municipalities to implement integrated public procurements, which are substantively similar to the future centralized procurements. Namely, in the last two years a unified public procurement for energy products, insurance and school furniture for elementary and secondary schools was implemented in Niš, while a unified public procurement for mobile services was implemented in Zrenjanin in 2015.

3.3. Technical capacities

In the EU regulations there are several directives which generally promote electronic procurements (e-trade) (Pearce & Platten, 2000). The European Commission in 2004 published an action plan for the implementation of electronic procurements, which is accompanied by the document that explains the rules of the e-procurement implementation (Commission of the European Communities, 2005). One of the most important segments of the framework for public procurements in the EU is related to the conducting of electronic auctions, which is covered by the Articles 1(7) and 54 of the Directive 2004/18/EZ (Arrowsmith, 2005). However, the results of earlier research showed that in most municipalities, regardless of size and level of development, there are no adequate technical capacities for the implementation of electronic auctions, neither for the implementation of other activities in domain of electronic procurement (Komazec, Todorović, Krivokapić & Jaško, 2013). On the other hand, all local self-governments are expected to significantly improve their technical capacities for implementation of all procedures provided by the Law on Public Procurements (2015), since the need for them will certainly be increasing as the Republic of Serbia gets closer to the EU. Centralization of certain activities in the field of public procurements at the local level emerges as a potential solution to this problem, since current situation suggests that smaller local self-governments for some time will not possess the technical capacities to independently conduct electronic procurements, so they will not have the ability to provide them independently.

Improvement of technical capacities can positively influence the expansion of personnel capacities of local self-governments in the field of public procurements. Implementation of software solutions for conducting public procurements can significantly reduce the participation of labor work in these activities.

4. MODEL FOR PUBLIC PROCUREMENTS CENTRALIZATION IN SERBIA

As mentioned previously, Belgrade is the only example of public procurements centralization at local level in Serbia. In many municipalities conducted situational analysis has identified significant space for personnel, organizational and technical capacity improvement in this area. Considering the expected effects of public procurement centralization and examples of good practice, such problems can be overcome by centralizing public procurements through the introduction of centralized procurement bodies at the local level. The body for the centralized public procurements should perform following functions:

1) Planning, implementation of procedures and realization of contracts,
2) Controlling public procurements,
3) Providing advisory services to purchasers.

Newly formed bodies for the central public procurements should act as mediators between the purchasers covered by centralization and suppliers, or to conclude framework agreements. Centralization of public procurements in Serbia should be conducted through the steps shown on the following figure.

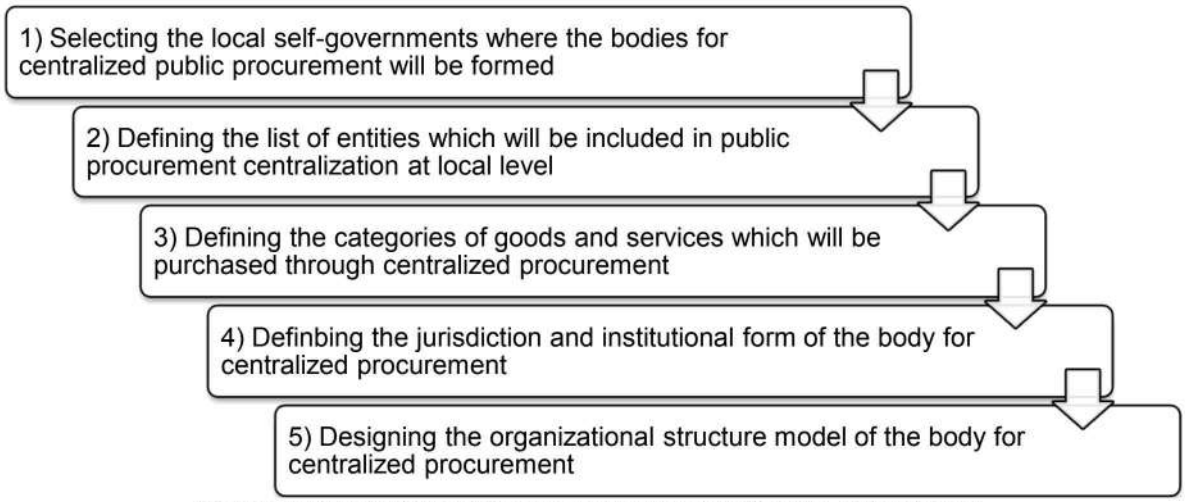


Figure 1: Model for public procurement centralization at local level

4.1. Selection of the local self-governments where the body for centralized procurement will be formed

As a first step there is a selection of the local self-government units in which centralization will be implemented. Criteria to be considered are: size of the local self-government, in terms of surface area of the territory, size of the budget and the number of budget beneficiaries. Based on situational analysis and interviews with the representatives of SCTM and Public Procurement Office, following 10 local self-governments should be included in the first phase of public procurement centralization in Serbia: Belgrade, Novi Sad, Niš, Kragujevac, Čačak, Kraljevo, Subotica, Zrenjanin, Užice and Pirot.

4.2. Defining the list of purchasers which will be included in the public procurement centralization at local level

Local self-government bodies should, by appropriate decision, define the list of the purchasers included in the centralized public procurements. Categories of institutions, enterprises and organizations that may be covered by such a decision are:

- City authorities (Assembly, Mayor, City government - organizational units etc.),
- Cultural institutions (theaters, museums, libraries, cultural centers etc.),
- Facilities for physical culture,
- Health care facilities (health centers, pharmacies, local institutes etc.),
- Child care institutions,
- Social welfare institutions,
- Public utility companies,
- Other companies and organizations founded by the local self-government.

List of entities which will be included in an annual plan of centralized public procurements is determined by numerous different factors, from which the most important are the number of institutions, companies and organizations in the local self-government territory, as well as the current capacities of local self-government to centralize public procurements.

4.3. Defining the categories of goods and services which will be purchased through centralized procurement

One of the basic decisions that should be adopted during the public procurements centralization is the subjects of centralized procurements. Based on years of experience in implementation of the central public procurements, and the best practice in this field in EU, it is possible to identify a list of products and services categories that are suitable for the public procurements centralization. With very few exceptions, by watching centralized procurements at all levels, the list of products and services is as follows (SIGMA/OECD, 2011):

- ICT products and services (computers, copiers, printers, servers, software, additional equipment),
- Products in telecommunication areas (networks, mobile phones, fixed phones),
- Office furniture,
- Travel services,

- Stationery (office supplies),
- Vehicles and transport services,
- Energy products (for heating and transportation, electricity),
- Food (groceries and meals),
- Employees' development services.

It is important to note that not all categories are equally suitable for the inclusion in the system of centralized public procurements at the same time of the centralization development at the local level. Enclosure of some categories (ICT – software, for example) can assume the existence of experience, primarily in conclusion of the framework agreements, possibly with multiple suppliers, and it cannot be the subject of centralized procurements from the very beginning of the centralization process. On the other hand, it is important to emphasize that, in terms of volume and contract value, the field of information and communication technologies is the most significant area of centralized public procurements in the EU states. Also, centralized procurements do not necessarily need to be limited to standardized and simple products and services. Central bodies for procurements in the EU have developed expertise for the centralized procurement of complex, advanced information systems, that takes into account the specificities of each order, that uses a technique of concluding a framework agreement with several suppliers, with a mini tender, which should enable subsequent necessary adjustments to the needs of purchasers (SIGMA / OECD, 2011). In addition, centralization of some of these categories may have limited effects at the local level (travel services, for example) due to probable small total value of such purchases. Therefore, the list should be seen as a framework for the initial selection of categories, or specific products and services that will be established by the certain regulation as objects of centralized procurements.

4.4. Defining the jurisdiction and institutional form of the body for centralized procurements at local level

As previously was mentioned, the body for centralized public procurements, in addition to planning, implementation and realization of procedures, also needs to control public procurements of all purchasers, as well as to provide advisory services and education to all users of budget resources at the local level. Accordingly, it is necessary to, at the highest level of abstraction, define the activities that this body performs, as well as its relations with other participants in the process of centralized procurements. For these purposes, the swim lane diagram presented on next figure was prepared, which shows the process flow through its core activities, and the participants who are responsible for carrying out each of them.

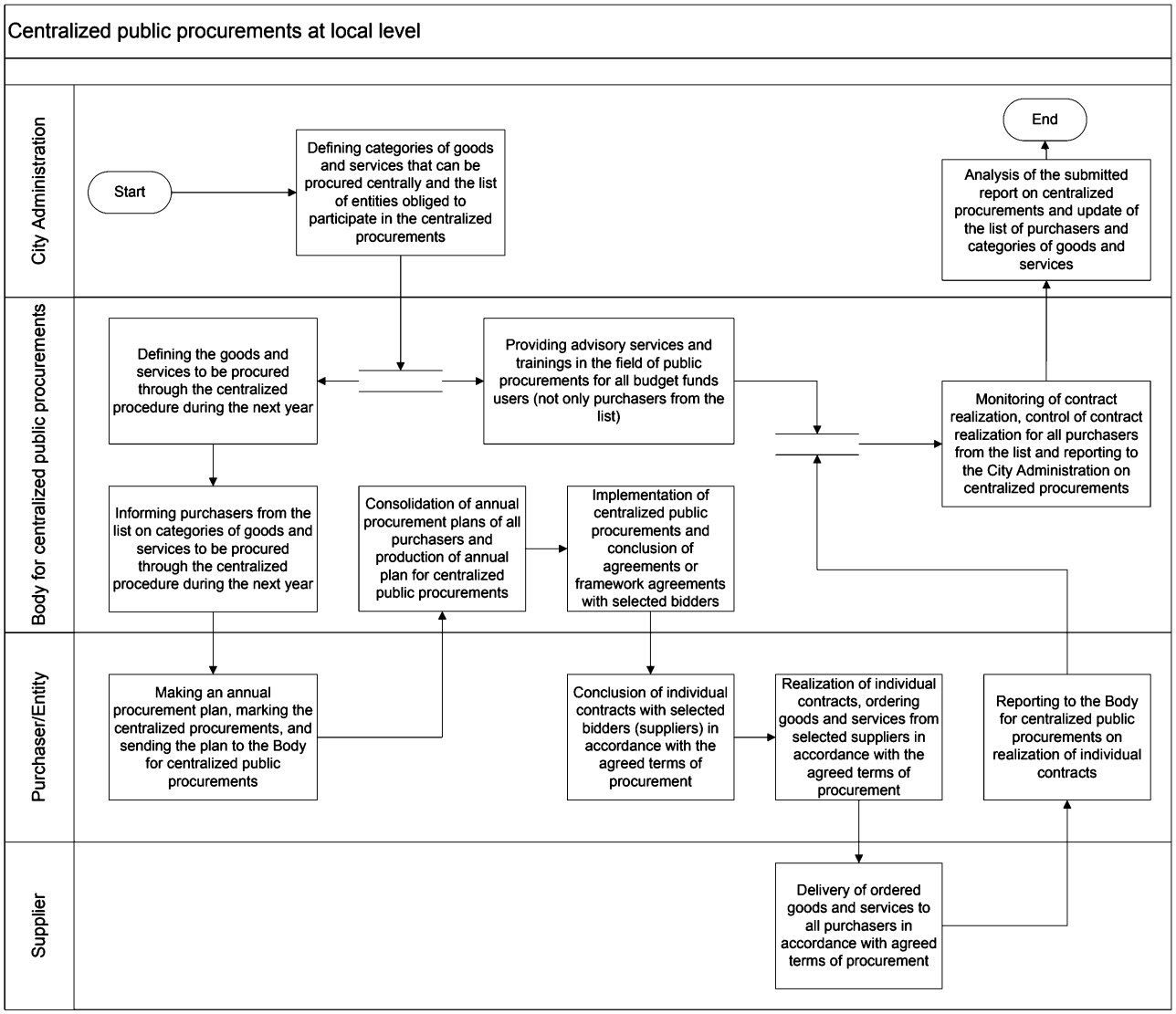


Figure 2: Process of centralized procurement at local level

The body for centralized procurements, at the beginning of each year, should make a plan of categories of goods and services which will be procured through centralized procedures in the coming year, to define the planned duration of the contract or framework agreement for each procedure, and in a timely manner notify all purchasers that are required to implement centralized procurements. Goods and services for which will be implemented centralized procurement must be included in the decision adopted by the city government, while the list of purchasers is also previously defined by the city authorities. Purchasers from the list, during the preparation of the annual procurement plan, should indicate the procedures relating to goods and services which are planned to be processed by the body for centralized procurement in the following year. After its adoption at organizational level, the procurement plan should be submitted to the body for centralized procurements. Through unification of the individual annual public procurement plans of all the purchasers from the list, the body for centralized procurements produces an annual plan for centralized procedures and defines the required attributes for each procedure, which will be implemented centrally.

After that, the body for centralized procurements implements centralized procedures for the relevant goods or services, according to the needs expressed by the purchasers in the annual procurement plan, and concludes the contracts or framework agreements with the best bidders. It is recommended that each procedure should lead to the conclusion of the framework agreement, especially in the initial phase of public procurements centralization, for the purpose of easier implementation and delegation of significant part of responsibility for realization to the purchasers. After completed procedure the purchasers who participated in it, conclude a joint contract with a selected bidder, or individual contracts if the framework agreement was concluded.

This is followed by the realization of contracts, during which each purchaser communicates directly to the supplier and orders the contracted amount, under the centrally conducted terms. Suppliers deliver the goods and services directly to the purchasers. During realization of the contract, all documentation is needed to be

prepared in two copies, as one could be delivered to the body for centralized procurements. Purchasers monitor the implementation of the agreement and submit a report on the implementation to the body for centralized procurements, together with the supporting documentation. The Body for centralized procurements monitors the implementation of contracts at the aggregate level, through the individual reports submitted by the purchasers. It is recommended that to perform various analyzes during this phase, in order to assess the effects of public procurements centralization and identify the savings. The body for centralized procurements simultaneously, through regular and ad-hoc revisions, controls the public procurement operations of purchasers, as well as of all other budget beneficiaries at the local level.

At the end of year, the body for centralized procurements reports to the city government on implemented centralized public procurement procedures. It also provides the results of conducted analyzes and the estimated savings. Based on this, the city government decides on any changes in the list of purchasers and categories of goods and services that must be procured centrally.

In parallel with the described activities, the body for centralized procurements consistently provides advisory services and education to all budgetary beneficiaries at the local level. They can be arranged at specific request of any purchaser, but also through organized seminars and trainings.

The body for centralized procurements should have the jurisdiction to conduct all required functions, which includes implementation, control and advisory. For this reason it is necessary to find a suitable organizational position in the city government for such entity, which on the other hand does not require significant structural changes that would slow down the implementation process at the very beginning. Taking into account the existing organizational structure of the city administration in mentioned cities, it is recommended that the body for centralized procurements, in the beginning, should be a specialized department within the organizational unit for public procurements. In further stages of public procurements centralization development at the local level, special attention should be paid to the institutional form and status of the body for centralized procurements.

4.5. Designing the organizational structure model of the body for centralized procurements

After defining the jurisdiction and the activities that an independent department for centralized procurements within the city service for public procurements should perform, it is necessary to define an appropriate model of organizational structure which will be applied to it. This includes the division of work and definition of typical workplaces within the department. Proposal of a typical organizational model of the department for centralized public procurements at the local level is shown on the following figure.

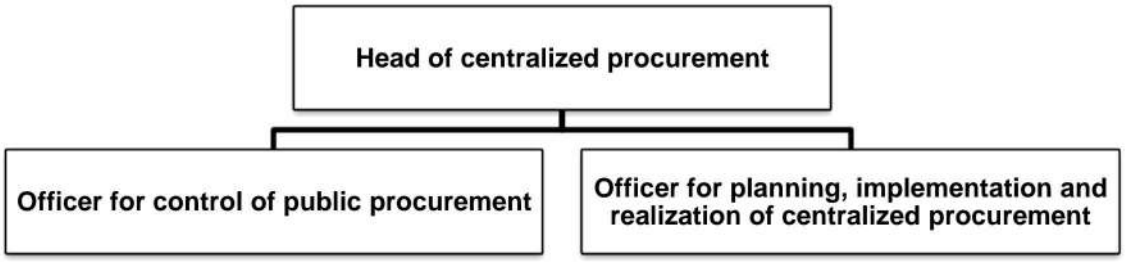


Figure 3: Organizational structure of the body for public procurements at local level

Number of employees on these workplaces should be adapted to the particular units of local self-government. It primarily depends on the municipality size, number of purchasers and number of procedures.

Head of centralized procurements is a typical workplace that should perform the following tasks:

- Governs the affairs of centralized public procurements at the municipality level,
- Annually proposes the categories of works, goods and services for which will be implemented centralized procedures,
- Proposes the annual plan of centralized public procurements at the municipality level,
- Appoints members of the commission for centralized public procurement procedures,
- Reports to the municipality administration representatives on implemented centralized procurements,
- Reports to the municipality administration representatives on the carried out controls of budget funds users in the area of public procurements.

Officer for control of public procurements is a typical workplace that should perform the following tasks:

- Controls the planning, implementation and realization of the centralized public procurement procedures,
- Plans and implements regular controls of all the municipality budget beneficiaries in the field of public procurements,

- Performs controls of the municipality budget beneficiaries in the field of public procurements,
- Provides advisory services to the municipality budget beneficiaries in the field of public procurements,
- Organizes and conducts trainings and education on public procurements for employees in the municipality budget beneficiaries.

Officer for planning, implementation and realization of centralized procurements is a typical workplace that should perform the following tasks:

- Collects annual procurement plans of the purchasers participating in the centralized procurements at the local level,
- Participates in preparation of the annual plan of centralized public procurements at the local level,
- Implements centralized procurement procedures in accordance with the approved annual plan of centralized public procurements,
- Monitors realization of the implemented centralized procurement procedures,
- Collects reports from purchasers on the implementation of individual contracts within the centrally contracted procurement procedures,
- Prepares reports on implemented centralized procurements,
- Provides advisory services to the municipality budget beneficiaries in the field of public procurements,
- Organizes and conducts trainings for employees on public procurements at the budget beneficiaries of local self-government.

5. CONCLUSION

Taking into account the examples of good practice regarding the public procurements organization at the local level, as well as the current situation in local self-governments in Serbia, public procurement centralization at the local level emerges as a logical improvement of the public procurements system in Serbia. The restructuring model presented in this paper is based on current personnel, organizational and technical capacities of local self-governments for performing functions of the body for public procurements, which makes it applicable. On the other hand, it incorporated the advantages of the public procurements centralization, while at the same time the potential risks were taken into account.

It is recommended to form the bodies for centralized procurements in selected cities in Serbia. They should play the intermediary role between the purchasers and the suppliers, and thus implement centralized procurement procedures for certain types of goods and services and for defined categories of budget beneficiaries at local level. In addition, the body should have an advisory function, and provide support in the field of public procurements to all budget beneficiaries on the territory of local self-government. Also, it needs to control non-centralized procurement procedures that budget beneficiaries conduct.

Described model should be seen only as a first stage in the public procurements centralization in Serbia. In later stages, bodies for centralized procurements should grow into the independent organizational units at the local level, which will create the basis for the formation of the regional centers for centralized public procurements and inclusion of a greater number of purchasers through joint procurements. Besides dealing with this issue, further research should also show the concrete benefits of the proposed public procurements centralization at the local level in Serbia, primarily in terms of actual economical savings and increased level of control.

REFERENCES

Albano, G. & Sparo, M. (2010). Flexible Strategies for Centralized Public Procurement. *Review of Economics and Institutions*, *1(2)*, 1-32.

Arrowsmith, S. (2005). The Law of Public and Utilities Procurement, 2nd ed. London, United Kingdom: Sweet & Maxwell.

Arrowsmith, S. (2009). EC Regime on Public Procurement. In Thai, K. V. (Ed.), International Handbook of Public Procurement, Edition: 1 (p. 251). Boca Raton, Florida, USA: CRC Press, Taylor & Francis. Retrieved from http://sate.gr/nea/international%20handbook%20of%20Public%20Procurement.pdf

Bovis, C. (2006). EC Public Procurement: Case Law and Regulation. Oxford, United Kingdom: Oxford University Press.

Brezovnik, B. & Oplotnik, Ž.J. (2015). Centralizacija javnih nabavki na lokalnom nivou u EU. In Brezovnik, B. (Ed.) "Centralizacija javnih nabavki na lokalnom nivou u EU". Lex Localis. Maribor, Slovenia: Inštitut za lokalno samoupravo in javna naročila.

Commission of the European Communities. (2004). Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions: Action Plan for the Implementation of the Legal Framework for Electronic Procurement. Retrieved from http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2004:0841:FIN:EN:PDF

Commission of the European Communities. (2005). Requirements for conducting public procurement using electronic means under the new public procurement Directives: working paper (SEC (2005) 959). Retrieved from http://ec.europa.eu/internal_market/publicprocurement/docs/eprocurement/sec2005-959_en.pdf

Decision of forming the Department for centralized public procurements and control of procurements in the city of Belgrade. (2014). *Official Gazette of the City of Belgrade 58(75)*. ISSN 0350-4727. Retrieved from www.sllistbeograd.rs/pdf/download/750/

Dimitri, N., Piga, G. & Spagnolo, G. (2006). *Handbook of procurement.* Cambridge, United Kingdom: Cambridge University Press.

Directive 2004/18/EC of the European Parliament and of the Council of March 31, 2004, on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts. Official Journal L, 134, 114-240. Retrieved from http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32004L0018:EN:HTML

European Parliament, Directorate General for Research. (1998). Measures to Prevent Corruption in EU Member States: working paper (Legal Affairs Series JURI 101 03-1998). Retrieved from http://www.europarl.europa.eu/workingpapers/juri/101/default_en.htm

Jansen, K.E. (2012). Razvoj organizacionih rešenja i preporuka za jedinice za javne nabavke u pilot gradovima. Analytical report within the project "Jačanje mehanizama odgovornosti u javnim finansijama". UNDP & Kingdom of Norway.

Komazec, S., Todorović, I., Krivokapić, Đ & Jaško, O. (2013). Capacities of Local Self-Governments in Serbia for Compliance with EU Directives on Public Procurement. *Management - Journal for Theory and Practice, 2013(69)*, 15-23. DOI: 10.7595/management.fon.2013.0030

Law on Public Procurement, *Official Gazette of the Republic of Serbia 14/2015*. Retrieved from http://www.paragraf.rs/dnevne-vesti/060215/060215-zakon_o_javnim_nabavkama.html

Pearce, G. & Platten, N. (2000). Promoting the Information Society: The EU Directive on Electronic Commerce. *European Law Journal, 6*, 363–378. DOI: 10.1111/1468-0386.00113.

Pegnato, J. A. (2003) Assessing Federal Procurement Reform: Has the Procurement Pendulum Stopped Swinging? J*ournal of Public Procurement, 3(2)*, pp. 145-175.

Sakane, T. (2009). Public Procurement in United Nation System. In Thai, K. V. (Ed.), International Handbook of Public Procurement, Edition: 1, 233-250. Boca Raton, Florida, USA: CRC Press, Taylor & Francis Group.

SIGMA/OECD. (2011). Centralized Purchasing Systems in the European Union, Sigma Papers, No. 47. Paris, France: OECD Publishing. Standing Conference of Towns and Municipalities (SCTM). *Mapping municipalities*. Retrieved from http://strategije.skgo.org/.

Transparency International – the global coalition against corruption. (2012). Corruption Perceptions Index 2012. Retrieved from http://cpi.transparency.org/cpi2012/results/.

PUBLIC PROCUREMENT CENTRALIZATION – FUNCTIONS OF THE CENTRAL BODY FOR PUBLIC PROCUREMENTS

Stefan Komazec*[1], Ivan Todorović[1], Miloš Jevtić[1]
[1]Faculty of Organizational Sciences, University of Belgrade
*Corresponding author, e-mail: komazec@fon.bg.ac.rs

Abstract: *In recent years, there have been major changes in the Republic of Serbia public procurement system. A new Public Procurement Law, which is completely in accordance with the legislation of the European Union in this field, was adopted in 2013. However, previous studies have shown that the contracting authorities do not use all the opportunities provided by the Law. The aim of this paper is to look at all the benefits and the risks of public procurement centralization at the local level, as one of the possibilities allowed by the Law. Also, the paper will propose functions and activities that should be done by the centralized procurement body, which represents a basis for later defining organizational models.*

Keywords: *public procurement, public procurement centralization, centralization model, central procurement body, functions of central procurement body*

1. INTRODUCTION

The issue of centralization of public procurement is a part of the wider issue of (de)centralization of the public administration, where, in the broadest sense, decentralization means any weakening of direct impact of a organized system centre to the parts of the same system (Brezovnik, Oplotnik, 2015). One of the main tasks of public administration organization is finding the balance between centralization and decentralization. However, unlike the other elements of public administration, flexibility in organizing public procurement process at various levels, or relatively simple ability to change the level of (de)centralization, keeps this area constantly in the focus of researchers. Centralization of public procurement at various levels, from local to national, is subject of constant reviews. In addition, organizational models which should support different degrees of centralization are also often in the focus of research.

On the other hand, despite the undoubted importance for the functioning of local government, public procurement is still characterized by ambivalences. Specifically, question whether the public procurement is the issue of regulations or a good governance is constantly raised among theorists and practitioners (Jovanović, 2015). The attitude that public procurement is a subject of regulation involves the focus on clearly defined procedures and rules for public procurement implementation. This approach to public procurement can easily limit the efficiency of processes, and achievement of the public procurement objectives. On the other hand, the attitude that public procurement is the subject of good governance presupposes that it is necessary to set up only a legal framework for implementation of the procedures within which it would be possible to achieve public procurement efficiency and effectiveness. However, not so strict rules for implementation of procedures, often lead to the occurrence of anomalies in the system, growing corruption, and the focus shifts towards regulation. When the system becomes too regulated and begins to "suffocate" efficiency, initiatives to reduce the regulation in this area are being re-implemented. It can be clearly seen the cyclicality in development of the public procurement system (Pegnato, 2003).

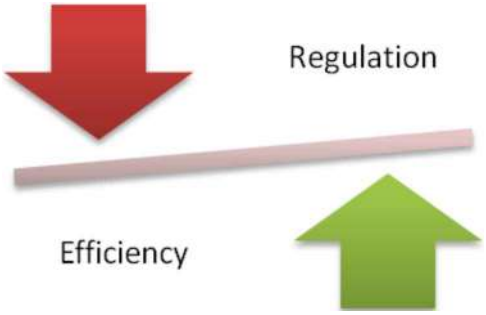


Figure 1: Strategic goals of public procurements

It can be said that there are two seemingly conflicting strategic objectives of public procurements, one is introduction of a higher degree of control, or regulation in area, while the other aims to attain efficiency and

effectiveness of procedures. However, by narrowly observing public procurements at the local level, it can be assumed that the centralization of public procurements at the local level can significantly contribute to the simultaneous fulfilment of both strategic objectives of public procurements, which will be described in detail bellow.

Special importance of public procurements at local level illustrates assessment that the share of public procurements in the local government budgets in Serbia, amounted an average 20-25% in 2011. It is obvious that public procurements have enormous significance in the management of public finances at the local level (Jansen, 2012). According to the Ministry of Finance and the Public Procurement Office data, the share of public procurements, which were undertaken by the city and municipal administrations in the value of local budgets amounted 7.2% in 2014 (Jovanović & Benković, 2012).

2. ADVANTAGES OF PUBLIC PROCUREMENT CENTRALIZATION

We will use the definition of the Central Purchasing Body - CPB from the Directive on the public sector of the European Union No. 2004/18/EC, in order to illustrate what the concept of centralized public procurements can relate on, regardless of the level of implemented centralization. The Central Purchasing Body is the authority which:

- Acquires goods and services for the needs of one or more purchasers (entities) from the public sector; or
- Concludes contracts for works, goods and services for the needs of one or more purchasers (entities) from the public sector; or
- Concludes framework agreements for works, goods and services for the needs of one or more purchasers (entities) from the public sector.

Benefits of the public procurements centralization are, in essence, common to all three forms of centralization, as will be explained below. In most cases, as the basic benefit of public procurements centralization at any level, reducing of the purchasing prices due the realization of economies of scale is emphasized. Enlargement of demand, by merging (joining) needs of more purchasers (entities), strengthens the negotiating power of a buyer, and creates the basis for achieving the lower prices of goods and services in public procurement procedures. Public procurements become more attractive to bidders, not only because of its size, but also because of the public sector nature and the payment security. On the other hand, on the supply side, certainty of large quantities sale creates the possibility for lower prices through reduction of the fixed costs share in total costs, but also through surely administrative costs reduction in contracting job, and possibly other costs in the process of product delivery (depending on the structure of delivery). All of the above circumstances, primarily on the supply side, are very clear when it comes to direct, centralized public procurement, in which the centralized body for public procurements directly buys goods or services from suppliers. In addition to direct price reductions, mentioned bargaining power may lead to better payment terms, price of the subsequent maintenance in terms of better organization of services, standardization of spare parts, specialization of repairers etc.

However, it is extremely important to pay particular attention on the framework agreements, as the most common output from the process of centralized public procurements. When concluding the framework agreement, the final quantity of goods or services to be delivered is not known, but possibly only an estimated amount. Automatically, it makes difficult for the bidders to assess their costs, and could become an obstacle to achieving the desired price reduction. On the other hand, the framework agreement will certainly lead to a greater number of smaller deliveries, which increases the bidders' costs and certainly reflects negatively on the economies of scale and the price reduction. Similar to the bidders, centralization of public procurements leads to cost reductions at the purchasers (entities). In any procedure, there are activities that must be carried out, starting from the eventual market research, to the conclusion of contracts in public procurement. Sometimes, the values of public procurements are so small that the question of cost effectiveness is being asked when compared to the value of acquisition and transaction costs, or expenses required to realize the process (Jovanović, 2015). Given that the public procurements centralization replaces more procedures with one, it is clear that it terminates repetition of the same activities at purchasers (entities) and reduces the transaction costs in the system. It is clear that the transaction costs of centralized procurement procedure will be greater than the costs of each procedure, but they will be less than the sum of costs of all replaced procedures. Reduction of transaction costs is primarily reflected in time release of certain employees for performing other activities. Conclusion of a framework agreement certainly brings higher transaction costs, especially if it comes to a framework agreement with several suppliers.

Establishment of the centralized procurement body, either at the national, or at the level of local government, leads to concentration of knowledge and skills in one place. The most experienced procurement officers should be employed in the body of that type, which opens up numerous opportunities for improving the

public procurement system. First of all, formation of this kind of expert centre will also enable implementation of the more complex types of procedures for purchasers for which such a type of procedure otherwise would be inaccessible due to lack of employees' knowledge. At the same time, concentrated knowledge in the expert center can easily be offered to purchasers, for implementation of procurements that are not centralized, whether through formal training or through the opening of a permanent communication channel. In addition, advisory services may also be required from purchasers who are not covered by centralization of public procurements at all, which strengthens capacity of the public procurement system.

In this regard, concentration of knowledge and skills in one body can overcome the lack of capacity of the individual purchasers for implementation of specific procedure types, or the specific public procurements. Many purchasers have a problem with implementation of procedures for goods, works or services that have been never purchased before. Another problem is the choice of an appropriate type of procedure, preparation of technical specifications etc.

In addition to experience and knowledge that the procurement officers "enter" into the body for centralized procurements at the local government level, the basis for use of these advantages creates formation of the **knowledge base** on public procurements. The knowledge base will be formed through work of the body, and will contain models of tender documentation, contracts, lists of suppliers, prices, product codebooks, technical specifications etc. Putting such a knowledge base available to all potential purchasers leads to the full utilization of public procurements centralization in terms of capacity improvement for the public procurements implementation at the local level.

Advantages arising from concentration of the best officers for public procurements and formation of the knowledge base will significantly reduce the risk that the public procurement procedure could be cancelled due to an error of employees. With regard that centralized procurements, as a rule, are implemented by the most qualified experts, the chances are greater that tender documentation will be better prepared in terms of quantification of quality criteria and other elements, and that the process will be well managed, unlike if it works each purchaser for itself (Jovanović, 2015).

Procurement subject standardization is often named as one of primary benefits that can be gained through public procurements centralization. Procurement subject standardization increases compatibility between institutions and opens possibilities for achieving better coordination and cooperation among the purchasers at the local level. It can be particularly important to emphasize standardization in the field of information systems. It is clear that the purchase of databases and other components of information systems from the same supplier facilitates the exchange of information and knowledge between the purchasers, but also facilitates control of purchasers by local government. On the other hand, standardization of procurement subjects among purchasers is one of the foundations for the later realization of economies of scale, where local government through the body for centralized procurements can eliminate unnecessary variations between the needs of purchasers.

Centralized procurements facilitate achievement of the public procurement policy objectives (SIGMA/OECD, 2011). The very nature of centralized public procurements, or a procedure that replaces procedures at more purchasers, represents an ideal basis for implementation of the public procurement policy, such as environmental, social responsible, etc.

The second strategic objective of the public procurements is to increase the control system, which is usually achieved through introduction of additional regulations in the system. However, centralization of public procurements at the local level in several ways contributes to improvement of the public procurement system control, without introduction of additional regulations and rules.

Centralization increases the transparency of procurements because several dozens of smaller purchases are replaced with a large one, which, due to its value and importance, attracts attention not only from suppliers, but often from the wider public (Jovanovic, 2015). In this regard, the relevant regulatory institutions much easier control a centralized procedure, instead of multiple processes at different purchasers, thereby significantly reducing the possibility of corruption and achieving the desired effect of introducing regulations. At the same time, capacity for control of individual public procurements at purchasers is being created in the expert centre, primarily in terms of knowledge, and possibly in terms of number of employees.

Centralization of public procurements contributes to reducing the risk of favouring pre-selected bidders. Customization of specifications and criteria in order to favour a particular bidder is usually based on local specificities in terms of delivery specifications, features etc. "Adjusting" specifications, criteria and requirements to the certain bidder is easily revealed on the centralized level than when the majority number of smaller purchases is being realized (Jovanović, 2015).

The following figure shows the positive impact of public procurements centralization at the local level for achievement of a strategic objective of public procurements – efficiency.

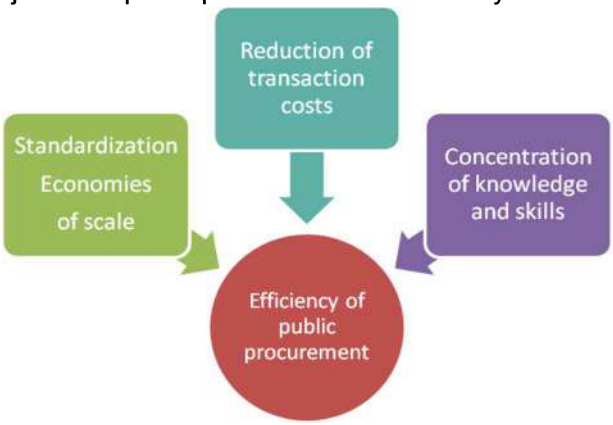


Figure 2: Public procurement centralization effects on public procurement efficiency

At the same time, public procurements centralization at the local level leads to increased control of public procurements, and to the fulfilment of the second strategic objective of public procurements - regulation.

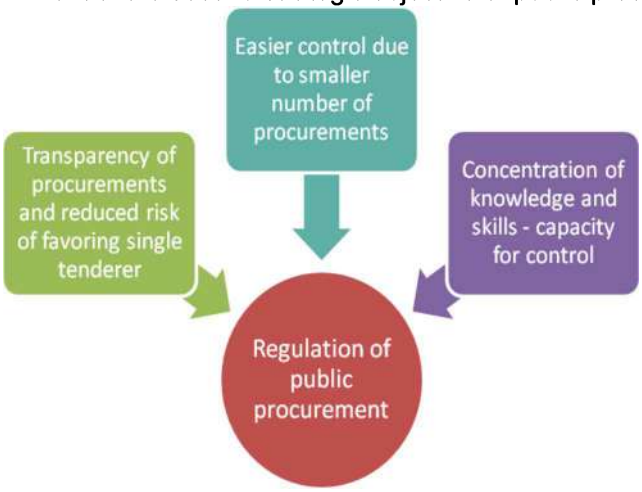


Figure 3: Public procurement centralization effects on public procurement regulation

3. RISKS OF PUBLIC PROCUREMENTS CENTRALIZATION

Public procurements centralization generally carries certain risks. However, the risks of centralization are directly linked to the level at the centralization is being carried, and the risks may be considerably smaller when it comes to the public procurements centralization at the local level.

3.1. Concentration of offers market

The main risks related to the public procurements centralization arise from the very essence of centralization and the basic advantages it offers, related to the integration of demand. There is certainly the risk that the higher purchased volumes will exclude a part of suppliers from competition, which could cause neutralization of opportunities for lower prices. Risk is particularly evident if only one bidder is able to meet mentioned needs, but even if it is not a single, but a small number of suppliers, there is always possibility of an agreement on the offered prices. In each of these situations, the bargaining power of suppliers is extremely high, which could be reflected on the other procurement conditions.

Generally, due to the mentioned characteristic of public procurements centralization, it can often be found the state that such a way of organizing public procurements, represents an insurmountable obstacle for small and medium-sized enterprises, because they cannot, primarily quantitative, respond to demand. More broadly, especially in the case of signing long-term contracts, this way of organizing public procurements can inflict some damage to the entire sector of small and medium-sized enterprises, because in addition to being unable to participate in large procurements, reduces the market of smaller purchases, on which they are

competitive . Consequently, this risk can get a certain political connotation, in terms of endangering an extremely important economic sector.

However, the smallest risks of this type occur during the public procurements centralization at the local level, because that is the lowest level of centralization within the public sector, and the value of procurement in most cases will not be a factor that limits competition. In addition, forward mentioned conclusion of the framework agreements can open the space for participation of small enterprises, provided they are price competitive, since the framework agreement does not involve one huge supply, but "withdrawal" of goods or services by the purchasers as required.

On the other hand, also in the case of complete public procurements decentralization there is no guarantee that the job will always get small or medium-sized enterprises, although statistical studies show that their chances in this case are higher (SIGMA/OECD, 2007).

3.2. Procurement of inadequate goods and services

Some risk is associated with the necessary standardization of goods and services in a procurement and possible inadequacy of the subject of procurement for all purchasers. Simply, during a centralized public procurements there is a risk that the specificities of the individual purchasers will not be fully taken into account. This type of risk is most pronounced when the body for centralized public procurements carries out procedures and buys goods or services from suppliers and sells them to purchasers. Then the risk may be manifested in the way that the purchasers do not want to buy inappropriate (inadequate) products and services from the central body, which threatens its financial stability and functioning. This risk is one of the main reasons for changing the basic role of the central body through the time, from the body which acquires products or services, and then sells them to purchasers, to body which concludes framework agreements for the needs of purchasers. Framework agreement defines the prices and estimated quantities of products or services, while the structure of each procurement (and later delivery) may be the subject of contracting directly with purchasers.

Also, attempts for reduction this kind of risk led to the limited list of purchase subjects that can be procured centrally, which will later be analyzed in more details. Viewed by the EU countries, centralized public procurements do not exceed 10% of the total value of public procurements (SIGMA/OECD, 2011). One of the reasons is that the integration of procurements does not apply to works that, in most countries, have a significant share in the total value of purchases. Also, the list of goods and services which may be subject of centralized procurements is very limited (Dimitri, Piga & Spagnolo, 2006; Albano & Spar, 2010).

3.3. Other risks

Centralized procurements are certainly more complex than decentralized. Their successful implementation presupposes well done market and potential bidders research, as well as regulations governing the areas relevant to the subject of procurement. This gives rise to a few risks. The first risk is the longer duration of the procurement procedure. The main difference in time for the centralized procurements implementation occurs in part of the process relating to the collection and aggregation of purchasers needs. Later, during the procedure, increased number of requests for protection of bidders (suppliers) could occurs in centralized procedures, because of a larger amounts of public procurement contracts and also because of long-term contracts.

On the other hand, experience from countries in which the framework agreements are used for a longer time has shown certain risks associated with this type of procurement procedure. Namely, in many cases, framework agreements have been concluded for a period of 2 to 4 years, which brings the risk of insufficient flexibility of the agreement, that can cover very difficult all the changes in the market or in technology that may arise during that period. As a tool for reducing this risk, concluding the framework agreements with multiple suppliers has appeared, where mini tender is organized only for the previously qualified bidders.

Also, during the public procurements centralization the risk of hidden corruption at the high levels increases. Decision about what will be the subject of centralized public procurement can favour a particular bidder or exclude its competitors.

One of the risks of public procurements centralization is increase in the costs of delivery, which affect the fact that the purchasers individually, locally can achieve lower prices outside the centralized public procurement. Therefore, the public procurements centralization at the local level imposes as an optimal solution for

reducing these types of risks, because location of purchasers within one local government cannot play a crucial role in the pricing of goods or services.

Specialists are needed for centralized public procurements. They will not only be familiar with a legal procedure, but also with the economy (market), and they should have a solid knowledge relevant for procurement subjects (Jovanović, 2015). Due to this, major risks arise in the case of centralized public procurements without previous education for staff.

4. MODEL FOR PUBLIC PROCUREMENTS CENTRALIZATION

An analysis of the situation in the member states of the European Union was conducted in order to define the optimal organizational model for the public procurements centralization at the local level. Activities the newly formed entity should deal with are also defined. One of the most important conclusions from the analysis of the situation in a part of the member states is that there is no standard organizational form of institutions (agencies) for the centralized public procurements (SIGMA/OECD, 2000), regardless of the level (national, regional, local). However, it is clear that the different forms and techniques of public procurements centralization are increasingly used in the European Union countries.

Definition in the Directive 2014/24/EU states: "The central purchasing authorities, with or without payment are responsible for, acquisition, dynamic purchasing systems management or public procurement awarding/conclusion of framework agreements for other public clients. From the very definition of the central procurement entity derives several possible models of public procurements centralization.

One of the models of centralization is the so-called "monopoly" model, in which the body for centralized procurements conducts public procurement procedures, purchases goods or services, and later sells them to institutions. In fact the body for central procurements acts as a wholesaler, with developed activities of purchasing, storage and eventual sale. This model of centralization involves great risks, particularly regarding the procurement of products which do not meet the needs of purchasers, and is rarely used in the member states of the European Union.

Essentially a different approach to centralization implies that the central bodies for public procurements act as intermediaries by awarding public procurements contracts to the bidders, also by management of dynamic purchasing systems, or by conclusion of the framework agreements used by public purchasers. In some cases this intermediary role can be carried out independently, by performing the appropriate procedures, without detailed instructions by the public purchasers, and in other cases by performing the corresponding public procurement procedures in accordance with the instructions of public purchasers, in their name and on their behalf.

Figure 4: Organizational models for centralized procurements

The model for centralization can be recommended, based, on the one hand, on reviewing the advantages of public procurements centralization and identified risks, and on the other hand on experience of the European Union. Centralization of public procurement at local level should be based on the model of organization in which the central body for procurements serves as a mediator.

Also, in order to maximize utilization of advantages offered by public procurements centralization, and eliminate identified risks, it is proposed the wider use of framework agreements with suppliers. This model can significantly reduce the risk of: buying inadequate products/services, lack of access to small and medium-sized enterprises on the centralized procurements market, inflexibility of public procurements and others. And Directive 2014/24/EU recognizes the framework agreement as an effective technique for conducting public procurements and recommends its wider use in Europe.

Introduction of new forms of centralized public procurements includes the following two things: firstly, institutional relations between organizations within the public sector, and secondly, establishment of appropriate organizational forms within the administrative departments of the state and local communities and outside that frame, or even outside the public sector with the aim of more efficient public procurements execution.

5. FUNCTIONS OF THE CENTRAL BODY FOR PUBLIC PROCUREMENTS

Once the basic modality of the body for central procurement functioning is determined, it is necessary to clearly define the functions that body is supposed to perform. The functions will clearly identify activities that should be performed within the body for central procurements. That will be set up the basis for designing optimal organizational structure.

Of course, achieving the basic purpose of the centralized public procurements, regarding reduction of public procurements cost through achievement of the economies of scale but also through reduction of transaction costs by replacing multiple processes with a unique procedure, the body for central procurements at the local level must implement public procurement procedures for the needs of as many purchasers. Purchasers' their procurement quantities should be sufficient to justify their inclusion in the process for central procurements. Procurement procedures should be completed by conclusion of the contracts with suppliers, or conclusion of the framework agreements with them.

On the other hand, to fully benefit clearly highlighted advantages that bring the concentration of knowledge and skills within one body at the local government level, the body for central procurement at the level of local government should have a clearly defined advisory function. Advisory function should be developed in several directions. First, communication channels must be developed which will provide that the employees experience and the knowledge base that is formed over time will always be available to all clients from the centralized system, in order to increase their ability of carrying out procedures that are not centralized. Secondly, the trainings held by employees of the central procurement body to the employees who are engaged in public procurements at the purchasers, should be formalized. And lastly, concentrated knowledge in the body of central procurements should be available to all direct and indirect budget users at the local level, thus strengthening the capacity for the public procurements implementation at the whole local government level.

Although it was said that the level of control in the public procurement system will increase by the centralization itself, because procurement enlargement facilitates control and increases transparency of procedures, one of the body basic functions at the local level should be public procurements control. However, the scope of public procurements control which should be implemented by the central body for procurements at the local level, cannot be defined a priori, but depends on the human and technical capacities of the body, number of budget users, number and value of procurements. Control function should be developed with the strengthening and development of the body for central procurements. Developing of the control function within the central procurement body of local governments should create the capacity for control of individual public procurements of direct and indirect budget users on the territory of a certain local government.

Taking all this into account, the basic functions of the body for central procurements of the local government are shown in the following figure.

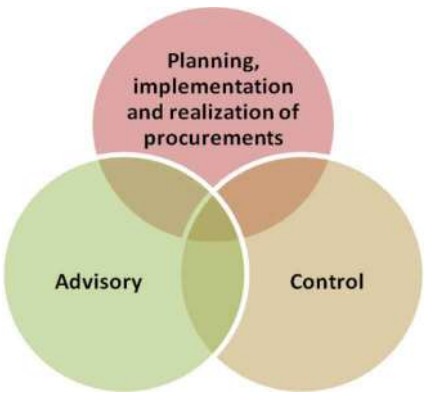


Figure 5: Main functions of body for centralized procurements

6. CONCLUSION

Based on the all written above it is clear that centralization of public procurement at the local level brings many advantages. However, any centralization carries with it certain risks. The paper noted that the risks of public procurement centralization slightest if it is implemented at the local level, but they cannot be ignored. Therefore, this paper proposed that the body functions of centralized procurement should be done in such a way to take advantages that centralization provides, but at the same time to minimize identified risks. It was suggested that the central procurement bodies at the local level should act as brokers and that should carry out public procurements in order to conclude framework agreements. Also, there is a need for development of advisory function in order to strengthen the whole system of public procurement. Over time, the bodies should strengthen the supervisory role in terms of the number of contracting entities which are controlled, but also in terms of the nature of checks they perform.

Further research should be focused on establishing the human, technical and organizational capacities of local governments in Serbia for the centralization of public procurement. Also, by highlighting functions of the central public procurement body should perform, the basis for the definition of potential organizational structure models has been created.

REFERENCES

Albano, G. & Sparo, M. (2010). Flexible Strategies for Centralized Public Procurement, *Review of Economics and Institutions*, 1(2), 1-32.

Brezovnik, B. & Oplotnik, Ž.J. (2015). Centralizacija javnih nabavki na lokalnom nivou u EU. U Brezovnik, B. (Ed.) *Centralizacija javnih nabavki na lokalnom nivou u EU*. Lex Localis. Maribor: Inštitut za lokalno samoupravo in javna naročila.

Dimitri, N., Piga, G. & Spagnolo, G. (2006). *Handbook of procurement* (Cambridge: Cambridge University Press).

Directive 2004/18/EC of the European Parliament and of the Council of March 31, 2004, on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts. Official Journal L, 134, 114-240. Retrieved from http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32004L0018:EN:HTML

Directive 2014/24/EU of the European Parliament and of the Council. Retrieved from http://www.hea.ie/sites/default/files/2014-24-eu_0.pdf

Jansen, K.E. (2012). *Razvoj organizacionih rešenja i preporuka za jedinice za javne nabavke u pilot gradovima, analitički izveštaj u okviru projekta „Jačanje mehanizama odgovornosti u javnim finansijama“*, UNDP i Kraljevina Norveška.

Jovanović, P. (2015). Centralizacija javnih nabavki u funkciji decentralizacije javne uprave i unapređenja performansi javnih nabavki. U Brezovnik, B. (Ed.) *Centralizacija javnih nabavki na lokalnom nivou u EU*. Lex Localis. Maribor: Inštitut za lokalno samoupravo in javna naročila.

Jovanović, P. & Benković, S. (2012).Unapređenje organizacije javnih nabavki na nivou lokalnih samouprava u Srbiji. *Management - Journal for Theory and Practice*, 2012(65), 25-32. DOI: 10.7595/management.fon.2012.0025

Pegnato, J. A. (2003) Assessing Federal Procurement Reform: Has the Procurement Pendulum Stopped Swinging? *Journal of Public Procurement*, 3(2), 145-175.

SIGMA/OECD. (2000). Centralized and Decentralizes Public Procurement, Sigma Papers, No. 29. Paris: OECD Publishing.

SIGMA/OECD. (2007). Central Public Procurement Structures and Capacity in Member States of the European Union, SIGMA Papers, No. 40. Paris: OECD Publishing.

SIGMA/OECD. (2011). Centralized Purchasing Systems in the European Union, Sigma Papers, No. 47. Paris: OECD.

DATA SCIENCE AND BUSINESS INTELLIGENCE 179

DATA WAREHOUSE FOR GLOBAL AIR TRANSPORT DEVELOPMENT 180
Nenadović Ana

AUTOMATIC CREATION OF CLINICAL PATHWAYS – A CASE STUDY 188
Kirchner Kathrin, Marković Petar, Delias Pavlos

ASSOCIATION RULE MINING: MODERN BUSINESS APPROACH 195
Istrat Višnja, Matović Dajana, Palibrk Milko

PREDICTING RISK OF BUYING LOW QUALITY CAR WITH RAPID MINER 201
Mitic Nemanja, Jankovic Ana, Vukicevic Milan

PREDICTIVE MODELLING FOR CLAIMS PROCESSING – CASE STUDY OF BNP PARIBAS 207
Sreckovic Stefan, Suknovic Milija, Vukicevic Milan

LOGICAL CLASSIFICATION METHOD FOR BANKRUPTCY PREDICTION 213
Marković Dragana, Živančević Sanja, Poledica Ana

BUILDING A DATA-ENRICHED DEX-BASED DECISION SUPPORT SYSTEM FOR EARLY WARNING ON INCREASED RISK OF SKIING INJURY OCCURRENCE – FIRST RESULTS 221
Marković Petar, Delibašić Boris, Suknović Milija

EUROPE 2020 STRATEGY – A MULTIVARIATE APPROACH 228
Milenković Nemanja, Đoković Aleksandar, Vukmirović Aleksandra

A FUZZY LOGIC-BASED SYSTEM FOR ENHANCING SCRUM METHODOLOGY 234
Stupar Mihailo, Milošević Pavle, Petrović Bratislav

APPLYING THE ANALYTIC HIERARCHY PROCESS TO RANK CITY-BRANCHES 241
Cvetkoska Violeta, Begicevic Redzep Nina

DATA SCIENCE AND BUSINESS INTELLIGENCE

DATA WAREHOUSE FOR GLOBAL AIR TRANSPORT DEVELOPMENT

Ana Nenadović
Faculty of Organizational Sciences, University of Belgrade
e-mail: ananenadovica@gmail.com

Abstract: *The paper will seek to familiarize the fundamental conceptual framework for understanding modern systems for decision support such is data warehousing, and present this concept through its application in the airline industry, certainly one of the most challenging business areas. The additional aim is to emphasize once again the usefulness of data warehouse as the basis for business intelligence solutions in competitive global environment. This presentation includes all necessary steps taken in the design and implementation of data warehouse. By relying research on the one of the major public data sources, the idea is to generate an intuitive system designed for wider audience to serve as a business intelligence tool – for making decisions regarding the choice of the optimal time, airport or airline for travelling. In the final part of the paper, the results of the data warehouse usage will be delivered in the form of presentations created in "Tableau Desktop" data visualization software.*

Keywords*: data warehouse, business intelligence, decision support, airline, on-time performance*

1. INTRODUCTION

Today is often referred to as the age of the information crisis which is related to the over-saturation of data, followed by the simultaneous lack of information in spheres of business and science *(Jennex, 2013).* This phenomenon reflects a situation in which organizations have a vast amount of data in their possession while at the same time the management have difficulty accessing the information they need for decision making. As for the individual companies, there are two main factors that cause the occurrence of this information gap. Due to the piecemeal systems implementation, data are often heterogeneous and inconsistent (*Hoffer, 2007).* In addition, these systems are designed primarily with the aim to satisfy the operational objectives. Data warehousing systems have announced a revolution in the way business organizations implement business analytics and strategic decision making in almost all industries. Data warehouse is the database designed for data analysis and as such still an indispensable and significant platform for developing business intelligence solutions *(Hawking, Paul, Sellitto, Carmine, 2010).*

As the phenomenon of large amounts of data and their immediate uselessness particularly affects industries that are global by its very nature, the problem of modern airline industry is therefore particularly striking. In times when the quality of customer services is in the focus of competitive business model, the impression is the general dissatisfaction of passengers who have an increasing freedom to choose from and immediately punish for failures by deciding to fly with another company *(Vasigh, Fleming & Tacker, 2013).* While traditional companies continue with confusing customers with various limitations, delays and with generally poor service, passengers are increasingly choosing new model of low cost airlines which offer transparent policy and affordable rates.

US Bureau of Transportation Statistics (BTS) collects data about domestic and international air transportation transactions. Thus, BTS is in possession of vast quantities of data that are publicly available for analysis and are significant source of knowledge about the global airline market. However, its datasets are difficult to manipulate by informal users which are assumed to be airline managers, the press, or ordinary passengers. The aim of this paper is to build an intuitive analytical system in order to ease working with data, so that users can gain the useful information faster and more easily. This would remarkably help pattern identification and process of creating influential reports *(Larsen, 2013).* As a result of that, gaining insights into traffic flows, flights statistics, most common delay reasons and the best time for trip would be instantly available. The limitations of reporting from BTS public data sets as well as the key advantages achieved by the implementation of data warehousing system will also be highlighted.

- Data are stored in huge datasets in CSV file format, and there is no easy and systematic way to obtain and compile the needed data. Accessing the data requires intensive and time consuming manual processing.
- There is no ability to perform custom analysis and drill down capabilities.
- There is no central place to view the data required for analysis and reporting.
- There is no automated way to get reports and quick predictions.

On the other hand, the data in the data warehouse are organized in a form that provides users with access to needed information through a minimal amount of effort and time. For this purpose is built a dimensional model that is largely intuitive and whose key benefit is data transparency. In addition, it provides a tool that guarantees the quality, accuracy and consistency of delivered data. These benefits generate the opportunity of better decision-making on the basis of theinformation not previously avaliable to the ordinary passenger.

Data warehouse for air transport data analysis ought to organize data retrievied from the web site Statistical Computing on page ASA Data Expo in a way which would provide an overview and insight into the on time arrival performance of passenger flights. The emphasis is thus on the key factors that influence the image of airline quality services such as reasons for delayed, diverted or cancelled flights.

2. DESIGNING THE DATA WAREHOUSE

The process of data warehouse development includes taking data from various sources and integrating them during which all inconsistencies are eliminated and data is transformed and archived in a way that best suits the needs of the end user.

2.1. Selecting and filtering data for analysis

On Time Performance Database contains on-time arrival data for non-stop domestic flights by major air carriers, and provides such additional items as departure and arrival delays, origin and destination airports, flight numbers, scheduled and actual departure and arrival times, cancelled or diverted flights, taxi-out and taxi-in times, air time, and non-stop distance.
Data are collected by BTS and consist of flight arrival and departure details for all commercial flights within the USA, from October 1987 to April 2008. There are nearly 120 million records in total, which take up 12 gigabytes when uncompressed. For obvious technical inability to process the amount of data, two annual files have been provided for the purposes of this work , more specifically, the subset of data covering the 2007 and 2008 calendar year.
When it comes to additional files supplied on the website, such as codebooks for airports, airlines and aircrafts, many irregularities have been observed: The table that provides data about the aircrafts and classifies them according to the model, age and the manufacturer has too many missing values, so it is estimated that this table is not useful at the moment, but is interesting provided that additional efforts are made for gathering data on aircraft registration codes and their origins. Afterwards, it was discovered that Airline codebook which ought to identify airline companies according to their IATA codes is not valid, i.e., contains information about fictive airlines, and is even not compliant with IATA coding system of two-letter codes. Similar is the case with the Airport codebook table, noting that the so-called IATA codes are actually mislabelled ICAO codes.
It was hence decided that new codebooks will be created according to the original data available on the IATA's website. Two tables have been generated in Microsoft Excel, for both the airline and the airport. The information these tables provide are details on two categories, custom facts about the flights dating from the period between 1998 and 2008. Therefore, the newly created table Airline based on the specific airline IATA code retained the information about its full name and USDOT (United States Department of Transportation) number based on its specific IATA code. Based on the particular airport IATA code, the Airport table returns the full name of the airport, latitude and longitude, the city and the country of airport.

As the data gathered and loaded into data warehouse come from different sources, the most demanding part of the entire project of data warehouse development is a process of data integration where the substantially different data from codebooks need to be associated with the transactional data in a single system. The whole set of procedures that collect and prepare data for loading in the final repository is referred to as ETL (Eng. Extraction, Transformation and Loading) processes. Prior to ETL processing the preparation of data is performed, which involves standardizing data in terms of unifying forms where the records of different backgrounds provide the necessary uniformity. On the other hand, data cleansing should be performed to remove all records that occur as a result of past mistakes. Possible cases of errors are incorrect, incomplete or inconsistent data.

2.2. Extracting data into staging database

After the process of data selection and preparation, in the first stage of the ETL process data are extracted into the staging database from which the data warehouse is being built. The packages populating the tables in the staging database are prepared in SQL Server Integration Services (SSIS) 2012. Database with transactional flights data is available in the separate annual CSV files. Each of the files contains approximately seven million rows. Using SSIS Platform for ETL processing, the available operator Union All combines multiple inputs into a single output data. Thus are the large annual files forwarded for further

processing. One of the problems that can occur when importing data from CSV to SQL Server is the issue of having to convert data types from Unicode data types to types of SQL Server. Through SSIS it is possible to enter the different types of data into the server. However, SSIS treats strings in CSV file as Unicode, while tables in SQL Server, are defined as non-Unicode. Microsoft services for data integration provide operators for conversion that are used in this step. The following operators have been applied: Data Conversion operator, whose role is to carry out the transformation of data types of corresponding columns and Derived Column that generates a new column or replaces the old one, by performing the transformation based on the given formula for the input column or more of them.
The package with which the annual files for 2007 and 2008 were extracted and loaded into the staging database Flights is shown in the following figure:

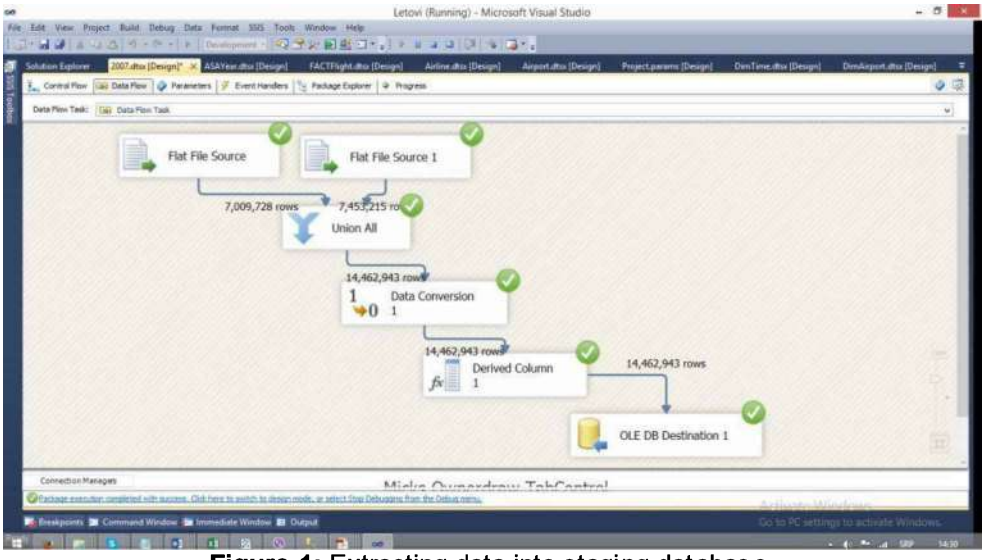


Figure 1: Extracting data into staging database

2.3 Dimensional modelling

At dimensional modelling this stage of a data warehouse it is necessary to determine how to logically group extracted data. The first step after selecting the grain of data warehouse is to choose the fact table, then the dimensions and schema of future data warehouse. When data is transferred from a source into the dimensional model, this means that we have one central fact table and a group of dimensional tables that are directly related to the fact table *(Kimball, Ross, 2013).* Facts are generally associated with numerical properties called measures. Dimensions are actually features that the client wants to analyze. The additional type of data stored in the fact table are codes, i.e. key attributes of dimensional tables by which these supporting tables are associated with the central table. The simplest and most often implemented schema is the Star schema *(Kimball, Ross, Thornthwaite, Mundy, Becker, 2010).* The Star schema is the core of Kimball methodology and because of its simplicity is closest to achieving a paradigm of business intelligence based on which its systems should be as intuitive as possible with the purpose of providing the end-user with the independent usage *(Adamson, 2010).*
The information we have in staging database Flights are records of individual flights in 29 columns concerning their timely performance or schedule deviations. More detailed information on the origin and destination of the flight as well as the airline that performed the flight are available in Airport and Airline tables.
The original dataset is extended by generating the table to which the role of time dimension will be assigned. Time dimension is one of data warehouse key components, as it provides its historicity. Firstly, columns Year, Month, and DayofMonth from the Flights table are unified into column that makes a specific date. Based on the date, Time dimension ID is generated to correspond with the same column in the fact table, with the role of key.
Selection of fact table in this case is unambiguous. Database Flights is the only one that records the transactions, and by its structure and composition is perfectly suited for the role of the fact table. In addition to a numerous measures and time determined facts it contains aggregated attribute and ID codes for airlines, airports and aircrafts. One of the most relevant measures is column ArrDelay that records the delay in minutes. Attributes that cover its special cases i.e. different reasons for the flight delay are also interesting. Database furthermore contains distance between the two airports, time spent in the air and other attributes that measure delay on the separate phases of flight. FactFlight contains 1448980 records and covers two calendar years starting from January 2007 and ending December 2008.

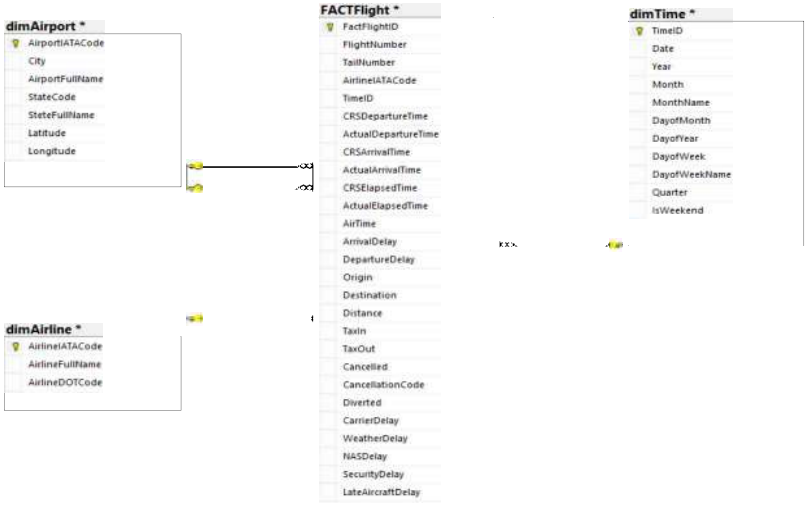


Figure 2: Data warehouse model diagram

Based on the information available in supporting tables, dimensional tables dim.Time, dim.Airport and dim.Airline are created. As IATA code uniquely identify a specific carrier and airport, there was no need for the implementation of the surrogate key on these dimensions, while the dim.Time ID is implemented in the form of a primary key that is similar to the timestamp, just as in the format YYYYMMDD as the most common practice (if there was necessity for greater level of granularity, it would contain hours, minutes, etc.).

Practically each of the dimensions contains a data hierarchy. The hierarchies are highly desirable because they allow users to analyze data aggregations in a very straightforward manner using the OLAP or data visualization software functions. Dim.Time appears to be self-explanatory and its hierarchy goes from year to the day of the month level of detail. Due to a particular nature of transactions, the columns quartile and weekend are also included because it is expected that the percentage of flights over the weekend as well as in particular seasons of the year will increase, rather than in others. Dim.Airport hierarchy simply allows individual airport data to be rolled up from IATA code, the full name of airport and the cities of origin/designation, to the names of the country.

2.4. Data warehouse implementation

The implementation of data warehouses marks the phase of physical design of the data warehouse and involves the whole process of data migration from operational or staging database into a central repository, including all necessary operations to be executed on the data, thereby customizing them for the future structure and purpose *(Sarka, Lah, Jerkič,* 2012). When the logical model is made, creating the database and its objects commences. Microsoft's SSIS tools for data integration are essential ETL tool and a platform for loading the traditional data warehouses.

Most of the data is loaded directly into the database tables, as is the case with the dim.Time which has already been prepared as being self-generated for the purposes of a specific data warehouse. The remaining dimensions, dim.Airline and dim.Airport are populated with necessary data in a similar manner. The column names are adapted semantically for the intuitive usage without a detailed introduction to metadata. Nevertheless, some transformations were necessary.

Similar problem that occurs when importing data from a CSV file in SQL server happens with transfering data from Excel tables. In SSIS some necessary conversions were made in order to store data in SQL Server tables. An additional problem occurs when transferring data from Microsoft Excel files. Because of the way that strings are stored in Excel cells, it is necessary to coverse data in WSTR form into SSIS. While it is possible to change the length of the string SSIS, Excel still keeps it in the internal form as if it were larger. As the SSIS string has the length of 50, one was to make a compromise and leave in the SSIS the column populated with the length of 50, all of which had no consequence on the query level. Same as before, to change the data type in SSIS package data flow pipeline, Data Conversion operator's functions has been used.

FactFlight is implemented according to the presented database model diagram in such a manner that the FlightNumber column was taken as the primary key , an attribute that uniquely identifies a particular flight. As mentioned earlier, the dimTime ID is made in the form of a date, and it was necessary to adjust the current

time attributes in the fact table to correspond the column in the time dimension as a foreign key. Columns for the year, month and day of the month have been integrated in the appropriate column that corresponds to the date in the dim.Time. For this purpose, the SSIS toolbox operator Derived Column Transformation creates new column or replaces the old one according to given formula.

Among the ArrDelay attribute records the extensive presence of NULL and 'NA' values was noticed where attribute values are less than or equal to zero. These are the cells that should not contain the values because it is the record of the flight for which the delay has not been recorded. The values in columns that indicate the reasons for the delay (WeatherDelay, SecurityDelay, LateAircraftDelay, CarrierDelay, NASDelay) for the flight codes which recorded t no delays, have been recognized in some places as a NULL, and in others are populated with 'NA'. It was necessary to make changes to the data, in order to make the string 'NA' recognized as a NULL in SSIS. By using the Derived Column Transformation operator, these particular values ought to be replaced. Within the Derived Column Transformation editor window it is possible to select the needed functions from the NULL functions folder, and in this case, the function that converts the DT_STR string values into NULL is chosen.

3. DATA DELIVERY

The work below illustrates data warehouse usage for the business intelligence solution development with the purpose of delivering useful information in the area of air transportation. For the purpose of this study and the particular data warehouse, the data visualization software Tableau is chosen.
1. What time of the year and days of the week are best to travel in order to minimize the likelihood of flight delay? – Presentation of flight delays by days of the week, months and seasons.

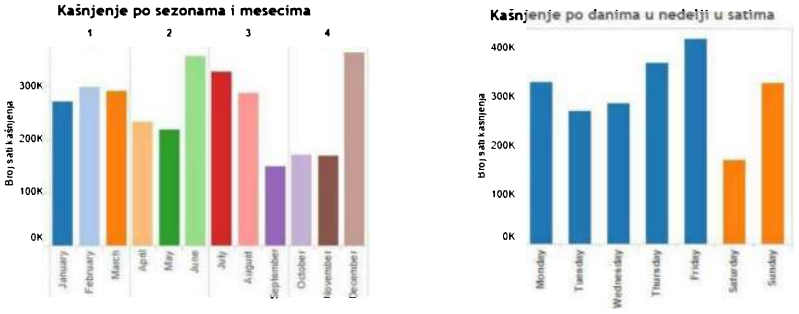


Figure 3: Flight delays per months, seasons and days of the week

Figure 3 represents the arrival delay measured in hours querying by time dimension. The first graph represents the total delays in hours per quarters and months. Filtered by months, each is marked with a different colour. Using the data hierarchy in Tableau is achieved by simply dragging the columns and is visible at the level of the data source.

In the second graph, the total delay per day of the week is presented. Bar colours indicate if it is weekend or working day. The vertical axis shows arrival delay measure values. As ArrivalDelay column records arrival delay in minutes, there are lots of negative values and delayed flights do not include the flights whose delay is less than 15 minutes, and the attribute is filtered to include only those values that are greater than or equal to 15. Similar data filtering could be done at the source level as Tableau allows connecting to the custom SQL query results.

2. What are the most common reasons for flight delay? - Presentation per months and in percentage.

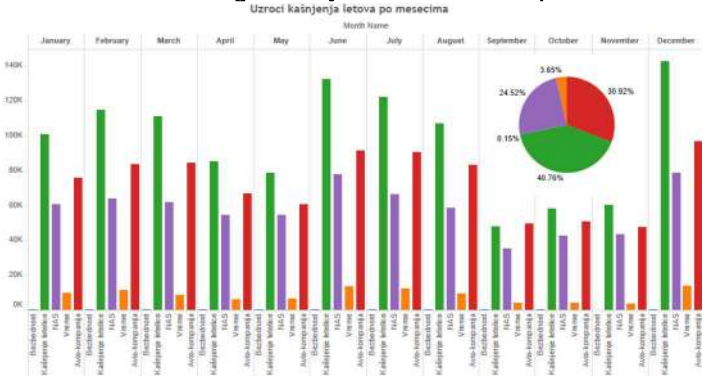


Figure 4: Presentation of specific delay reasons

As in the previous examples, when one wants to compare multiple categorical values, the best solution for graphical representation is a bar chart diagram. In the following diagram, the time axis is partitioned by months where for each month the most influential factors on flights delay are comparatively observed. Different colours mark individual delay reasons. The measure expressed by a total number of delay in hours records the values in the range from 189 to 142.433.

Pie chart graph shows the delay reasons in percentage. Comparable distinctive measures of the same category analysis in the Tableau is solved by filtering the field Measure Value. When connection to the data source is made, Tableau automatically generates fields Measure Values and Measure Names which are the parameter of all available measures, and inside of which the selection of any required measure is performed.

3. How does the weather affect the flight delays? – Presentation showing the correlation of total arrival delay and delays caused by weather conditions.

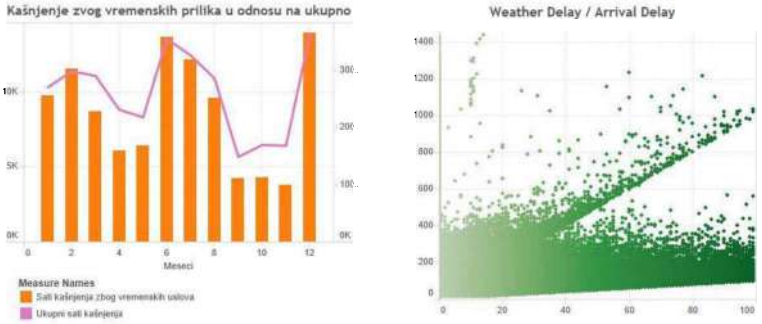


Figure 5: Weather delay and total arrival delay correlation

Although the previous analysis has shown that weather conditions have a small percentage in the total amount of flight delays, drawing the diagram in which it is possible to examine comparable trends of two dimensions, indicates strong correlation between these two measures. The impact of weather on total delay is shown by scatter plot graph where the weather is placed on the horizontal axis, whereas the vertical axis represents the total delay in hours. Pie chart graph shows the percentage of flight cancellation caused by weather in the total amount of cancelled flights. Database records are filtered keeping the cancelled flights, and this value is further broken into subcategories where each of the separate reasons is presented by different colour.

4. Which airports and airlines are more prone to delays than others? – Presentation of airports and airlines with the highest delay rate.

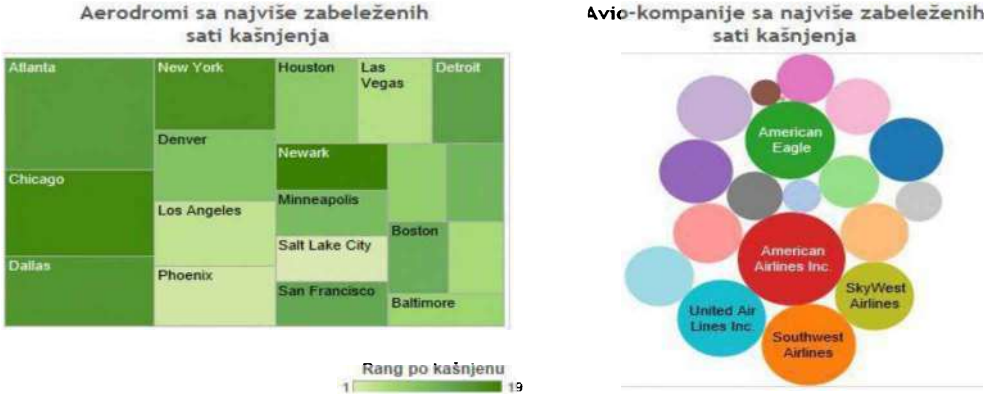


Figure 6: Airport and airlines

Airports are at first examined through the tabelar presentation where the calculated field that counts the amount of delay by the number of reported flight for an individual airport is generated. Thus are the airports that are most prone to flight delays discovered. These are then ranked and shown in a more intuitive way by drawing heat map chart where you can best see thescale and they were ranked according to arrival delay frequency. In the first graph in Figure 6. shows the airports using their full names, where the intensity of the color displays the values from 1 to 19, in a manner that the largest number is assigned to the airport with the highest delay level expressed in hours by number of records for the particular airport.

When it comes to airlines, the following graph in Figure 6. presents airlines with full names, marked with different color, and the size of the airline displays the total amount of delay for the airline expressed in hours. Thediagram does not show the airline with a negative value of the total delay. Further analysis has shown that it is Aloha Airlines.

5. What air lines include the highest traffic density? – Presentation of city pairs that represent most frequent routes.
Tableau allows for the possibility to analyse paths between two geographical points. To visualize these patterns, special data structure is required. Table Route is generated from the data warehouse as a SQL query result, and contains information about all routes realized between any two airports. As Tableau for this kind of analysis requires a specific data structure, Route table was not necessary to link with others in the data warehouse schema. For every data pair the unique key is made that identifies them as a pair. Each path takes two rows in the table, one for both of the directions, so a column was created in the table to define the path order according to latitude and longitude of the origin airport.

Table 1: Route Table

Column Name	Description
Origin	Origin airport IATA code
Destination	Destination airport IATA code
OriginAirportfullName	Origin airport full name
DestinationAirportfullName	Destination airport full name
Latitude	Origin airport latitude
Longitude	Origin airport longitude
PathOrder	Path order number (1 or 2)
RouteName	Route full name

By connecting Tableau to the Route table a map is generated showing a network of all itineraries shown in Figure 7. Different color is assigned to each route. The thickness of the lines represents the number of flights realized between the two airports of the particular route. Ability to filter itineraries is made possible by generating the parameter, according to the number of realized flights based on which they are ranked. It is possible to locate the intersection nodes of two airlines on the map.By filtering the map of the 30 most frequent routes, their names will appear.

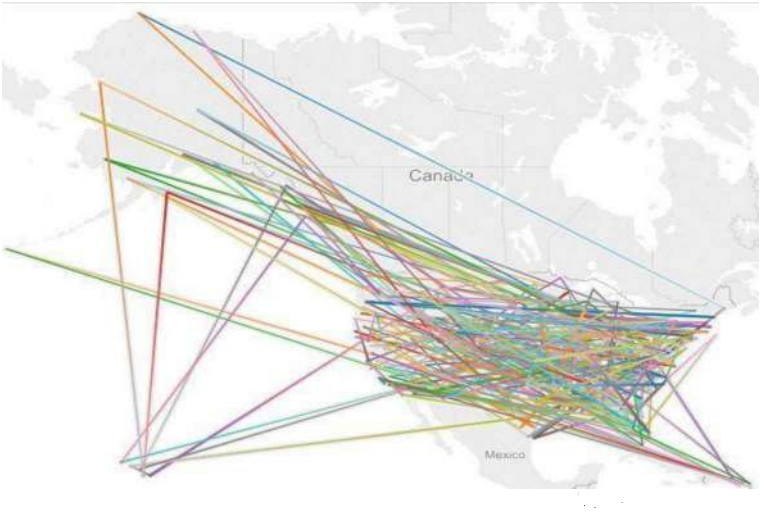


Figure 7: Route network

4. CONCLUSION

Business intelligence has evolved because the grow of data altering how organizations and individuals use information (Larson 2016).The subject of the paper was designing and implementation of the data warehouse for the air transportation data analysis. In the times when the informed customer is on the very first place of a succesful business model, the lack of quality information is visible when it comes to air transport services quality*(Davenport, 2014)*. Although there are some sources of open data in the area of flight performance, they are useless in a straightforward manner and require time consuming and manual processing effort in order to get and compile data. There was no automated and systematic way for the

simplest analysis to be done. A data warehousing system is a platform for business intelligence solutions development, and enables what was not possible before – to organize data from various sources in a thematic and intuitive way, therefore providing the users with an integrated tool for performing the most demanding analytical operations on data in a fast and easy way.

The aim of the study was the use of publicly available data for creating business intelligence solution that would provide assistance to passengers in the choice of time, place and the airline for trip, in order to avoid long waits, jams and other air traffic inconveniences caused by delays. As the schedule deviation is one of the key reasons that influence the airline quality valuation by the passengers, it is necessary to emphasize the importance of the availability of data as the basis for making decisions of this kind, which would be grounded upon the reliable knowledge.

REFERENCES

Adamson C., (2010). *Star Schema: The Complete reference*, The McGraw-Hill.

Davenport T. H. (2014). *Big data @ work: dispelling the myths, uncovering the opportunities*. Harvard Business Review Press.

Hawking, Paul and Sellitto, Carmine, "Business Intelligence (BI) Critical Success Factors" (2010). ACIS 2010 Proceedings. Paper 4.

Hoffer J, Marry B. Prescott & Fred R. McFadden,(2007).“Modern Data Management”, Eight Edition, Pearson Prentice Hall, New Jersey.

Jennex E., (2013). *Knowledge discovery, transfer, and management in the information age*, IGI Global

Kimball R., Ross. M,(2013).*The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling*. Wiley.

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

Larsen T., (2013).Cross-Platform Aviation Analytics Using Big-Data Integration Methods, *Integrated Communications Navigationand Surveillance (ICNS) Conference.*

Larson D., and Chang V., (2016) A Review and Future Direction of Agile, Business Intelligence, Analytics and Data Science. International Journal of Information Management, 36, (5), 700-710.

Sarka D, Lah M, Jerkič K,(2012). *Training Kit (Exam 70-463):Implemmenting a Data Warehouse with Microsoft SQL Server 2012*, Microsoft Press Training Kit, 1st edition.

Vasigh B., Fleming, K.,& Tacker, T.(2013). Introduction to Air Transport Economics: From Theory to Applications. Ashgate Publishing.

AUTOMATIC CREATION OF CLINICAL PATHWAYS – A CASE STUDY

Kathrin Kirchner*[1], Petar Marković[2], Pavlos Delias[3]
[1]Berlin School of Economics and Law, Germany
[2]University of Belgrade, Faculty of Organizational Sciences, Serbia
[3]Eastern Macedonia and Thrace Institute of Technology, Kavala, Greece
*Corresponding author, e-mail: kathrin.kirchner@hwr-berlin.de

Abstract: *In hospital environments, treatment processes, respectively clinical pathways, are adopted based on the health state of a patient. Modeling of pathways is time consuming and due to the involvement of many participants, the introduction of clinical pathways is cost-intensive. A possibility for automatic or semi-automatic creation of clinical pathways is process mining. But such algorithms usually have problems to discover such processes from log data that are recorded during process execution in information systems. In this paper, we discuss the application of a spectral clustering algorithm to cluster process flows that can provide clearer process maps. We apply this method on an anonymized real world clinical dataset and discuss challenges and first results.*

Keywords*: clinical pathway, process mining, spectral clustering, flexible process, case study*

1. INTRODUCTION

A clinical pathway is defined as a structured, multidisciplinary care plan which defines the steps of patient care for a certain disease in a specific hospital (Rotter et al., 2010). They can improve the efficiency and transparency of patients" treatments: Length of stay in the hospital as well as cost can be reduced, patient safety is increased and new medical personnel can learn more quickly how a certain treatment process is executed.

A clinical pathway is usually developed manually by the medical personnel which is costly and time consuming. A once modeled pathway has to be updated regularly so that it is always following new regulations. An automatic support of clinical pathway creation would therefore be helpful (Rebuge & Ferreira, 2012).

A possibility for automatic or semi-automatic creating clinical pathways is process mining. Process mining is an emerging field that connects business process management and data mining (van der Aalst, 2012). It has three general purposes: as-is business process discovery from data, conformance checking of detected processes with pre-designed process models, and enhancement of the process model. In this paper we concentrate on the first topic. Process mining is used in industrial and administrative processes. Mans et al. (2012) applied process mining algorithms in a dentistry case, and found that it was difficult to handle flexibilities in the pathways. Poelmans et al. (2010) used process mining on breast cancer data and faced problems with data quality.

In process mining the structuredness of processes can vary between the so-called: “Lasagna processes” - simple in structure, consist of a relatively small number of activities and have a consistent flow, and the other side of the spectrum, which corresponds to “spaghetti processes” - with a very diverse and inconsistent process flow, and a large number of activities. Thus, the first are easier to analyze using standard process mining algorithms and techniques, whilst the second are more challenging.

One problem for process mining of clinical pathway data is the amount of flexibility in patient treatment which leads to spaghetti processes. An approach proposed by Delias et al. (2015) suggests applying clustering algorithms to group similar traces before applying a process mining algorithm, and this way reduce the high amount of different traces.

In this paper, we apply this approach by Delias et al (2015) on data collected from a clinical information system (Kirchner, 2015). We investigate whether spectral clustering can solve the problems with process flexibility in our case study. Challenges are discussed, and ideas of further improvement are developed.

Thus, our paper is structured as follows: In section 2, we describe the medical data that we analyze in section 3. Section 4 discusses our findings. In section 5, we summarize our results and give an outlook on future work.

2. DATA AND METHODOLOGY

During the research project PIGE (Kirchner et al., 2013), a clinical pathway for living liver donors was modeled in BPMN together with the medical personnel. This process was modeled by hand within a team of physicians and process modeling experts. Afterwards, data from a clinical information system was added to the process steps. This data contained timestamps and the name of the treatment procedure for a certain patient.

The process can be roughly described as follows: A healthy person can donate a part of her/his liver to a near relative. Before one becomes a living donor, she or he must undergo testing to ensure that the individual is physically fit. Sometimes computer tomography (CT) scans or magnetic resonance tomography (MRT) are done to image the liver. The pre-examinations are predetermined, but can change in the sequence depending on the availability of necessary resources. During and after operation, complications can occur that lead to additional interventions or even an additional operation. The data set was extracted from a clinical information system. All patient data which were marked as living liver donors in a time period of 3 years were selected. The resulting data set contained 50 living liver donors with 331 events. Not all patients went through all process steps. If the pre-examination found the person not suitable for donating the liver, an operation is not done. Therefore, the number of process steps for patients was different. Patients that were already in a later process step in the considered time period were also in the data set. Thus, not all pathways had the same start- and endpoint. Furthermore, the timestamp for all events were only dates, and several events can be done on a day.

Data was analyzed in a first step using Fuzzy miner algorithm in the version implemented in Disco software (www.fluxicon.com). Fuzzy miner uses correlation metrics to simplify the process model at a certain level of abstraction. To solve problems with flexible pathway execution, it can ignore less important activities or cluster them (Günther & van der Aalst, 2007). Figure 1 shows our first obtained process map that we obtained as a spaghetti process. The map comprises 45 process variants for the 50 patients. The shortest pathway contained only one event, the longest one 26 events. Filtering out seldom used pathways, as it is possible with Fuzzy miner, would delete also pathways with interesting characteristics (e.g., complications after operation).

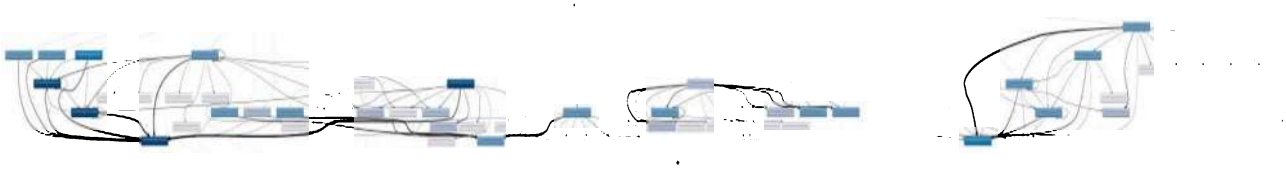


Figure 1: Original Process Map for living liver donors discovered by Disco-Fluxicon

For successfully analyzing such spaghetti processes, some form of data preprocessing is necessary. The most common approaches are filtering of activities and/or traces (cases) or clustering of activities and/or traces (cases). Some of the widely used clustering approaches can be found in (Veiga & Ferreira, 2010), (Song, Günther, & van der Aalst, 2009), (Jung, Bae, & Liu, 2009), (Bose & van der Aalst, 2009), (Luengo & Sepúlveda, 2012). Besides this, there is a group of robust algorithms such as (Delias et al, 2015), that efficiently resolve spaghetti processes in the domain of healthcare without any filtering, and which we chose to apply in this paper.

Our methodology applied in this paper is based on the methodology proposed by Delias et al. (2015). Thus, the following five steps were applied:

1. Creation of Event log from the hospital information system
2. Traces generation from the Event log
3. Calculation of traces" similarity using cosine similarity and robust similarity concept
4. Spectral clustering
5. Visualization of obtained clusters

3. DATA ANALYSIS

The first step in the implementation of our methodology is the creation of an event log, which is a starting point in any process mining analysis. Data were created from the hospital information system. For that purpose, a query was defined on the information system, selecting all patient treatments for patients marked as possible living liver donor. In order to follow the data security requirements, no personal information was extracted and patient identification numbers and dates were anonymized. The structure of the resulting event log used is shown in figure 2. Mandatory fields for further analysis are: Patient ID, Activity (Treatment Procedure) and Timestamp. The rows in the event log represent occurrence of a single event in the system (e.g., patient is sent to do the „CT of Abdomen" or the patient is sent to the „Operation room").

Patient_ID	OPS Code	Treatment Procedure	Day of treatment	Admission day	Discharge day
12345678	3-225	CT: Abdomen	10.10.2014	10.10.2014	12.10.2014
12345678	3-226	CT: Pelvis	10.10.2014	10.10.2014	12.10.2014
....					
23456789	3-225	CT: Abdomen	08.02.2015	08.02.2015	10.02.2015
....					

Figure 2: Event log structure

In order to reduce the complexity of the data, we analyzed which activities are often executed together on the same day. We calculated the co-occurrence matrix (Fig. 3). It consists of 32 activities, whilst the values of cells represent the average number of appearance of activities A and B in days where there were at least two activities per case. The matrix is symmetrical, as ordering of activities is not important (e.g. it is irrelevant if A follows B, or vice versa). The most frequent co-occurring activities in the heatmap are represented with red color, medium co-occurrences with black, whilst the least frequent combinations are colored with green. From the matrix, we derived that six activities, namely CTs and MRTs of different parts of the body (activity numbers 5, 6, 7, 19, 20 and 21), are often (at least in 20% of all cases) done on the same day. Therefore, we grouped them into a new activity named "CT/MRT diverse". Selection of merging candidates was done by reading the heatmap values, but the domain knowledge was the main criterion used for final decision. Therefore, e.g., activity number 9 (partial resection of liver) as part of operation of patient was not merged with pre-operational steps like activity number 5 (radiopaque CT abdomen). The steps that are described in the next section were applied on this modified data set.

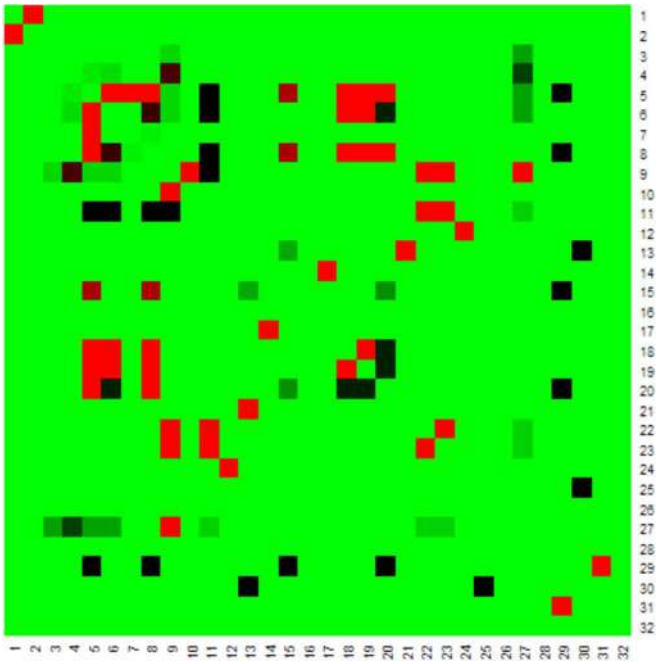


Figure 3: Co-occurrence matrix for the data set

When the structure of the event log is known, traces are generated from it. Traces represent process paths of each recorded case (patient). In other words, traces can be observed as chronologically ordered vectors of patients" activities. They are obtained from the event log, when activity fields, from all recorded events in

the event log, are ordered chronologically and grouped by case ID. The example of a single trace is given in the figure 4.

Patient ID 12345678: <CT: Abdomen, CT: Pelvis>

Figure 4: A single trace (example)

After all traces are created, it is necessary to calculate their similarity in order to find the groups of patients" process paths that have high intra-group similarity, but are very different compared to the groups. In terms of process mining, two popular criteria for process similarity are: activity similarity and transition similarity both represented with corresponding vectors and defined with formulas 1 and 2, respectively.

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

$$SIMactivities(T_i, T_j) = \frac{a(i) \cdot a(j)}{|a(i)||a(j)|} \frac{\sum_k a_k(i) \times a_k(j)}{\sqrt{{}_k a_k(i)^2 \times {}_k a_k(j)^2}} \quad (2)$$

The first formula (1) presumes that two cases (patients) are similar if they undergo the same medical procedures, whilst the latter presumes that two cases are similar if they undergo those procedures (activities) in the same order. These two types of similarity are combined into overall similarity, represented with their convex linear combination - formula 3.

$$s(T_i, T_j) = S_{ij} = W_a \cdot SIMactivities(T_i, T_j) + W_t \cdot SIMtransitions(T_i, T_j) \quad (3)$$

Weights of the overall similarity components are determined based on expert judgement. Due to data quality issues we preferred to give more weight to transition similarity. All similarities are cosine similarities of corresponding vectors.
Lastly, the robust similarity is calculated using local densities concept (Chang & Yeung, 2008). The reason for using this approach is to enable low-frequent, outlier traces, to be spotted and prevent their influence on the clustering process. The idea behind the robust similarity concept is that an object, surrounded with more objects, should have higher chances to be grouped together with his neighbors. The measure used for estimating local density is given in formula 4 as s'_{ij} l_i represents local density of the object.

$$l_i = \sum_{j \in N_i} S_{ij} \text{ where } N_i \text{ is neighborhood of an object } i$$
$$s'_{ij} = s_{ij} l_i l_j \quad (4)$$

This overall robust similarity is represented in the form of similarity matrix and represents the entry point for the spectral clustering step. Visualization of similarity matrix is given in the Figure 5 in the form of a heatmap, where the most similar cases/traces are colored with red, cases with medium similarity colored in black, and the least similar cases colored in green.

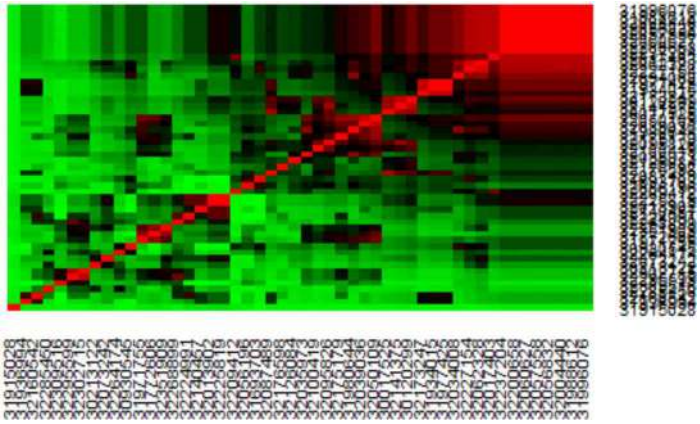


Figure 5: Heatmap of traces" (cases/patients) similarity

Spectral clustering (von Luxburg, 2007) is the following step, and consists of two substeps. First, the Laplacian matrix, which is derived from similarity matrix obtained in the previous step, is analyzed using its eigenvectors and their corresponding eigenvalues in search for the optimal lower-level subspace representation of the starting matrix. This is achieved through selection of first k eigenvectors of the Laplacian matrix which capture the highest variability in the data. They can be observed in the figure 6 as the eigenvectors after which exists a significant drop in the eigenvalues. Afterwards, the number of first n eigenvectors from the previous substep is used as a parameter k (number of clusters) in the K-means clustering algorithm. For our experiment, we selected k=2 as the number of clusters. Final results are discovered clusters consisting of similar traces. Each case"s corresponding cluster number is added into the event log.

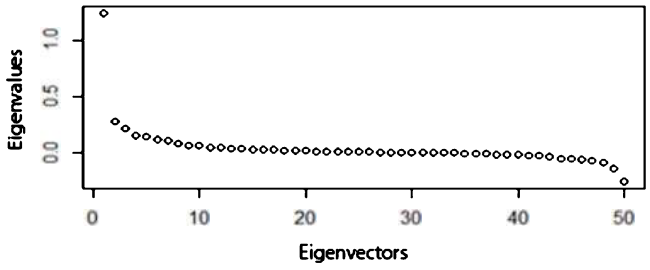


Figure 6: Eigenvectors and eigenvalues for the similarity matrix

The final step consists of visualizing obtained process maps using Fluxicon Disco process mining tool, and it is described in detail in the following chapter.

4. DISCUSSION OF RESULTS

After a careful interpretation of the heatmaps and the eigenvalues, we tried several numbers of clusters as well as different weights for the activities and transitions similarities. We then analyzed the resulting clusters and tried to identify the cluster solution that fits the best from the application point of view.

We achieved the best results with activity similarity of 0.1 and transition similarity of 0.9. Two clusters were identified, one of them (cluster 1) being illustrated in figure 5 contains 28% of cases and 30% of events. The longest path has 8 events, the shortest only three events (Figure 7). In principle, three types of clinical pathways can be derived here:

1. Patients that undergo the usual treatment: A pre-evaluation phase to check whether they can become a living liver donor and the operation phase.
2. Patients that undergo the usual treatment, but have complications after the operation
3. Patients who undergo just the pre-evaluation phase, but are not considered as living liver donors, so the treatment process finishes earlier.
4. Furthermore, there were also 2 patients that were already in the operation phase in the time period that was considered for the data collection. Therefore this pathway starts immediately with the operation.

The second resulting cluster was similar to the first one, but consisted of 72% of the cases. Here, cases having several process steps processed on one day are included. Because of data issues (date format) the process discovery algorithm cannot have a clear picture of what the sequence of events on a specific day was, therefore, the process execution seems to be very flexible. We could reduce this flow variability through a preprocessing step that merges the frequently co-occurring process steps (i.e., steps occurring frequently on the same day). More than 80% of cases are unique, and half of the cases have less than 5 events. Therefore, it is impractical to discover a process map that summarizes the behavior of the second cluster. Other techniques that could describe marginal aspects of the process (e.g., association rules) could add some value in process comprehension, yet they are out of the scope of this paper.

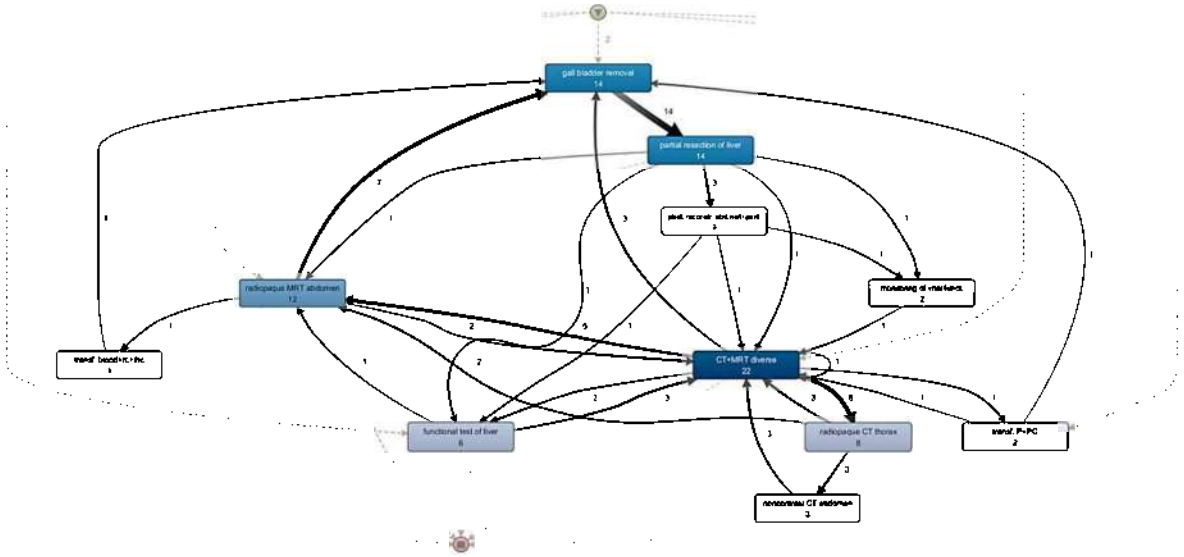


Figure 7: Resulting process map for cluster 1 of the data set (Visualization created with Disco-Fluxicon, 100% activities - 100% for transitions)

5. CONCLUSION AND OUTLOOK

In this paper we tried to discover patterns of process behavior for a particularly flexible environment: the living liver donors" treatment process. Since variability of flow is commonly expected in such a healthcare setting, we applied a trace clustering approach to summarize the flows.

The case study posed some additional challenges, because of the coarse timestamps, the small size of sample, and the large deviation of the pathway sizes. However, we were able to reach two significant results: First, there is a cluster of cases that exhibits some strong patterns, and we were able to plot them with a process map. Medical personnel could benefit from such a map by gaining a quick yet comprehensive understanding of the process. Second, trace clustering approaches are inappropriate to deal with the remaining population.

It is within our future plans to elaborate on the more idiosyncratic part of the population by applying different approaches (e.g., declarative/hybrid models, association rules, using patients" characteristics to correlate them with flows, etc.), to mine for any possible hidden underlying patterns.

REFERENCES

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

Chang, H., & Yeung, D.-Y. (2008). Robust path-based spectral clustering. *Pattern Recognition, 41(1)*, 191-203.

Delias, P., Doumpos, M., Grigoroudis, E., Manolitzas, P. & Matsatsinis, N., (2015). Supporting healthcare management decisions via robust clustering of event logs. *Knowledge-Based Systems*, 84, pp.203-213.

Günther, C. W. & van der Aalst, W.M.P. (2007). Fuzzy Mining – Adaptive Process Simplification Based on Multi-perspective Metrics, *Proc. of BPM 2007*, 328–343.

Jung, J.-Y., Bae, J., & Liu, L. (2009). Hierarchical clustering of business process models. *International Journal of Innovative Computing, Information and Control 5(12)*, 1349–4198.

Kirchner, K. (2015). Toward Automatic Creation of Clinical Pathways. *Proc. of 1st EWG - DSS Int. Conf. on Decision Support System Technology*. Belgrade, Serbia, 32, ISBN: 978-86-7680-313-2.

Kirchner, K., Herzberg, N., Rogge-Solti, A. & Weske, M. (2013). Embedding Conformance Checking in a Process Intelligence System in Hospital Environments, *BPM 2012 Joint Workshop ProHealth 2012/KR4HC 2012*, Tallinn, Estonia, 126-139.

Luengo, D., & & Sepúlveda, M. (2012). Applying Clustering in Process Mining to Find Different Versions of a Business Process That Changes over Time. *Business Process Management Workshops vol. 99*, 153-158.

Mans, R., Reijers, H., van Genuchten, M., & Wismeijer, D. (2012, January). Mining processes in dentistry. In *Proceedings of the 2nd ACM SIGHIT International Health Informatics Symposium*, 379-388. ACM.

Poelmans, J., Dedene, G., Verheyden, G., Van Der Mussele, H., Viaene, S., & Peters, E. (2010). Combining business process and data discovery techniques for analyzing and improving integrated care pathways. In *Advances in Data Mining. Applications and Theoretical Aspects*, 505-517. Springer Berlin Heidelberg.

Rebuge, Á., & Ferreira, D. R. (2012). Business process analysis in healthcare environments: A methodology based on process mining. *Information Systems*, *37*(2), 99-116.

Rotter, T., Kinsman, L., James, E., Machotta, A., Gothe, H., Willis, J., et al. (2010). Clinical pathways: effects on professional practice, patient outcomes, length of stay and hospital costs. *Cochrane Database Syst Rev*, 3(3).

Song, M., Günther, C., & Aalst, W. (2009). Trace Clustering in Process Mining. In D. Ardagna, M. Mecella, & J. Yang (Eds.),. Business Process Management Workshops vol.17, 109-120.

Van der Aalst, W. (2012). Process Mining Manifesto. Business Process Management Workshops, 69-194. Berlin: Springer.

Veiga, G., & Ferreira, D. (2010). Understanding Spaghetti Models with Sequence Clustering for ProM. Business Process Management Workshops vol. 43, 92-103

Von Luxburg, U. (2007). A tutorial on spectral clustering. *Statistics and computing*, *17*(4), 395-416.

ASSOCIATION RULE MINING: MODERN BUSINESS APPROACH

Višnja Istrat*[1], Dajana Matović[1], Milko Palibrk[2]
[1]Faculty of organizational sciences, University of Belgrade
[2] Administration for Joint Services of the Republic Bodies
*Corresponding author, e-mail: visnja.istrat@gmail.com

Abstract: *The business problem has been elaborated by analyzing data through methods and techniques of business intelligence, with emphasis on association rules. In this paper attributes in the air traffic field have been analyzed in order to determine the conditions for landing of the aircraft. Based on the applied data model it could be determined if an aircraft can land on predefined conditions, or not. The business problem has been elaborated in real-world setting. Evaluations of landing conditions and prediction through association rules have big relevance because the safety of the landing of the aircraft with crew could be significantly improved. Research in this paper shows the potential and significance of business intelligence application in air traffic management.*

Key words*: business intelligence, association rules, sustainable business development*

1. INTRODUCTION

Suknović (2001) defines ˝Decision making is the selection of one from the group of available alternatives" (p. 14). It is a very complex process that should result in getting appropriate managers' decisions. Therefore, it is necessary to continuously research and improve methods and techniques of modern decision making. Perfect solution for the defined problem does not exist. The highlight should be on the most acceptable solution. Managers should know well the Theory of decision making, as well as how to use practical experience to get the business decision that will result with maximization of profit.

Suknović (2001) discusses the three dimensions that determine the complete development of this discipline. These are: qualitative, quantitative and information-communication aspects (p. 13). These three aspects implicate all concepts of development of modern decision making, on both theoretical and practical level. ˝Quantitative approach in modern decision making defines the basic formalism of general decision making problem˝ Suknović and Delibašić (2010) point out. Suknović (2001) defines ˝the decision making problem is a five item problem $(\mathrm{A}, \mathrm{X}, \mathbb{F}, \Theta, \succ)$ where (p. 13):

A: represents a definite set of available alternatives (actions) ranked by a session participant in order to select the most acceptable one;

X : represents the set of possible outcomes as a consequence of selecting an alternative;

Θ: represents a set of world states, and depends on the unknown state $\theta \in \Theta$ because the consequences of selecting alternative $\alpha \in \mathrm{A}$ may differ;

$$\mathbb{F}: \mathrm{A} \times \theta \rightarrow \times \tag{1}$$

for each world state ϖ, and for each alternative α, determines the resulting consequence $\mathrm{X} = \mathbb{F}(\alpha, \varpi)$

$\succ$: weak order relation on X, i.e. a binary relation that satisfy the two following criteria:

i) Completeness: either $\mathrm{X} \succ \gamma$ or $\gamma \succ \mathrm{X}, \forall \mathrm{X}, \gamma \in \mathrm{X}$;

ii) Transitivity: if $\mathrm{X} \succ \gamma$ and $\gamma \succ \mathrm{Z}$ then $\mathrm{X} \succ \mathrm{Z}$, $\forall \mathrm{X}, \gamma, \mathrm{Z} \in \mathrm{X}$.

Relation $\succ$ features the decision maker and is called a preference relation Two other important relations can be derived from the preference relation. The first is the strict preference relation where $\mathrm{X} \succ \gamma$ if and only if both $\mathrm{X} \geq \gamma$ and not $\gamma \geq \mathrm{X}$. The second is the indifference relation where $\mathrm{X} \sim \gamma$ if and only if $\mathrm{X} \geq \gamma$ and $\gamma \geq \mathrm{X}$. The most often way of solving decision making problems is the transformation of weak order $\succ$ to X into normal order $\geq$ over the field of real numbers by the means of utility functions. *Authors Anderson, Sweeney, Williams, Camm and Cochran (2015) describe quantitative methods of decision making (p. 154).*

Recommendation is that manager posess relevant experience, knowledge and wisdom in using the techniques and methods of modern decision making. *Behaviour of managers has been described by authors Bazerman and Moore (2012) on (p. 103).* Intuition is also important in the decision making process, as well as the proactive approach of solving problems. Intersection of different scientific disciplines points out to interdisciplinary framework of modern decision making.

Recommendation is that strategic positioning of business entity is oriented towards life-long learning and application of methods and techniques of modern decision making. The goal is achieving business excellence and leadership position in business environment. *Organizational decision making has been described by author Pettigrew (2014) in book (p. 229). Authors Power, Sharda and Burstein (2015) describe the latest tendencies in business decision support system (p. 20). Efficient strategies for mining association rules have been described by the authors Nguyen, Vo and Le (2014) in their research (p. 4716). Authors Howson and Hammond (2014) discuss the benchmarking of companies from the field of business intelligence with latest business solutions (p. 57). Latest tendencies of decision support system have been described by author Sauter (2014) on (p. 35).*

˝Association rules are useful tool for extracting new information from raw data described in comprehensive manner for decision makers" is defined by authors Ruiz, Gómez-Romero, Martin-Bautista, Sánchez, Vila and Delgado (2015) in their research (p. 247). Concept of association rules and datasets has been discussed by authors Simovici and Djeraba (2014) in their research (p. 647). Mining of association rules through new statistical method has been described by authors Zhang and Shi (2016) on (p. 10). *˝Analysis of relations between different technologies could result with maximization of profit. Association rules have been suggested for determination of dependencies between technologies", Altuntas, Dereli and Kusiak (2015) on (p. 249). Ding, He and Liang (2015) show the comprehensive system of evaluation of association rules (p. 304).*

*Humphrey (2005) describes SWOT analysis (**S**trengths, **W**eaknesses, **O**pportunities & **T**hreats Analysis) as technique of strategic management where strategic choices that connect and evaluate internal strengths and weaknesses of companies with opportunities and threats of external environment˝, (p. 7). SWOT analysis application was described by authors Ayub, Razzaq, Aslam and Igtekhar (2013) in their research (p. 92).* Table 1 shows the overview of significance of SWOT analysis of business decision making for business entity. Internal strengths and weaknesses of the business entity have been analyzed that relate to the process of business decision making. Based on the shown SWOT analysis, it is concluded that strengths and opportunities of the concept of business decision making are much better and more prosperous than the weaknesses and threats.

Table 1: SWOT analysis of significance of business decision making for business entity at the market

Strengths	**Weaknesses**
Higher effectiveness of managers' decisions. Strengthening of process of decision making. More effective management team. Educated human resources with knowledge and experience in decision making. Systematic positioning of concept of business intelligence in decision making process.	Continual costs of training and education of managers. Waiting time to see the effects of decisions. Uncompetitive management. Unavailable high-quality literature of topic of business decision making.
Opportunities	**Threats**
Better positioning at the market. Maximization of profit. Growth and development of business subject as consequence of taken suitable manager's decision. Taking leadership position at the market. Improved communication. Transparency of business.	Poor business of company as result of wrong manager's decision. Bad choice of strategic partnerships that leads towards bankruptcy of the company. Wrong choice of information from external sources that leads towards wrong decision making. Resistance of the environment towards changes.

Source: Author

2. RESEARCH FRAMEWORK

This paper describes the process of data mining concept implementation by creating model of association rules. CRISP-DM methodology and software Orange have been used in the research. *More details about*

phases of CRISP-DM methodology can be seen in research of Suknović and Delibašić (2010). Business problem consists of analyzing data of an air traffic field by methods and techniques of business intelligence, with highlight to association rules. Attributes and conditions for landing of an aircraft have been analyzed. Based on the applied data models it will be evaluated if an aircraft could land or not, taking into account weather conditions.

Evaluation of landing conditions and predictions through association rules have big significance because based on this the safety of an aircraft with crew has been evaluated. Datasets from real-term business settings have been used. There were 253 data iterations processed. Attributes that are being researched are: stability, consistency, magnitude, wind, altitude and visibility. Numerical values have been shown in database with *tab (tab delimited file) format, which is suitable for processing in software Orange.

After software evaluation, it was concluded that data in this format were prepared for modeling phase. Modeling is the central and the shortest phase of the process and it is done by numerous software solutions for data mining through algorithms. In further research of database of an air traffic, Apriori algorithm has been used. *More about Apriori algorithm can be seen in book by Adamo (2012) on (p. 33).* Solution will be effectively applied in real-term business settings. Association rules have been generated. (p. 47).

Figure 1 shows desktop of an open-code software Orange, which was used during the research. On the left-handed side there is menu with options for data processing and tools of business intelligence. On the right-handed side there is desktop space where models of business intelligence are being created. Icons are being connected on the certain pattern and therefore models of different purposes have been created. *Authors Rouhani, Ashrafi, Ravasan and Afshari (2016) describe the influence of model of business intelligence to decision making and organizational benefits (p. 19).* Figure 1 shows the model of association rules application that has been used during the research.

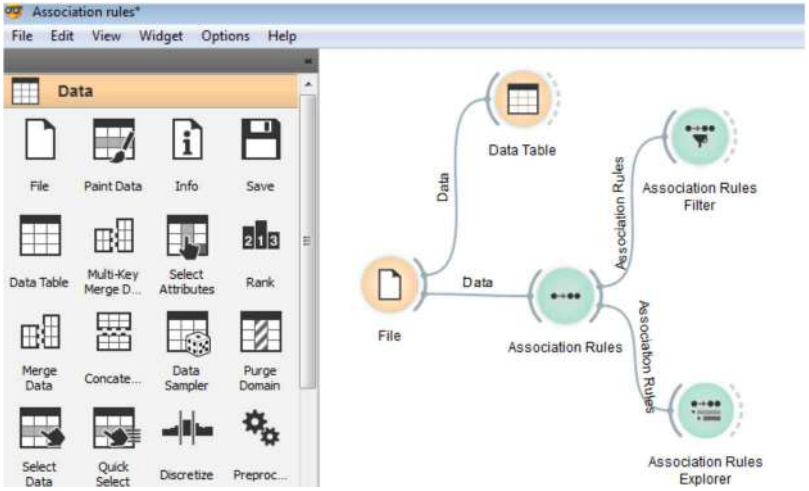


Figure 1: Desktop of software Orange

Further analysis provides overview of data without missing values. The iterations of data are clearly shown, as well as the visibility and data value of the collected data for the research (Figure 2). *Authors Fan and Bifet (2013) describe mining of big databases, as well as future tendencies in this field (p. 3).* After data preparation and immediately before modeling, these characteristics have been shown:

- Database on Figure 2 contains 253 data iterations. Taking into account that data are from real business settings and that it is very difficult to get data from the real business system of air traffic, it is concluded that database is on satisfactory level for the analysis.

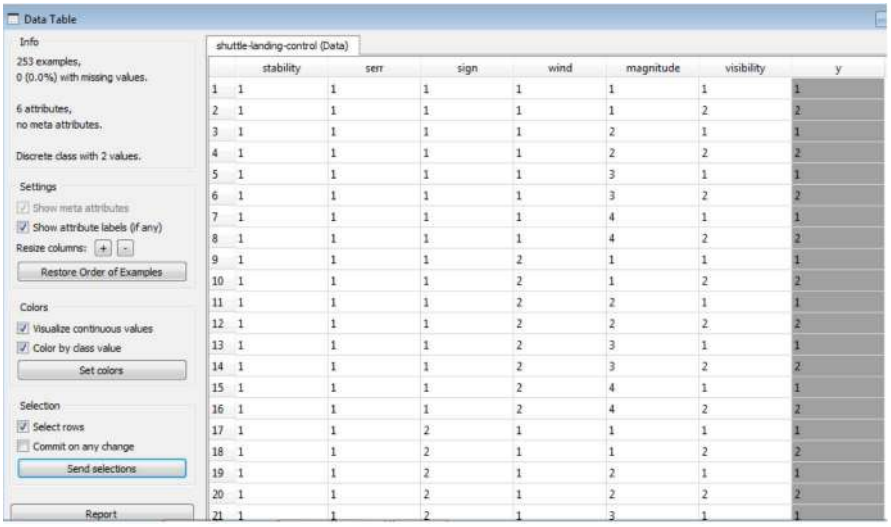


Figure 2: Overview of project data

- After an extensive research of domestic search engines and databases, it is evident that there is no scientific paper that is dealing with the application of association rules as part of business intelligence applied on the real data in air traffic field. Therefore, there is need and interest for research of this field.
- It rarely happens that when preparing data from database there is no missing values. However, when it is case, then further prepare data before processing is needed by special algorithms and processes.. It is concluded that existing database is very suitable for further research.
- Six attributes present the important items that analyze parameters necessary for evaluation of landing the aircraft.

Figure 3 shows list of five association rules by using generic model.

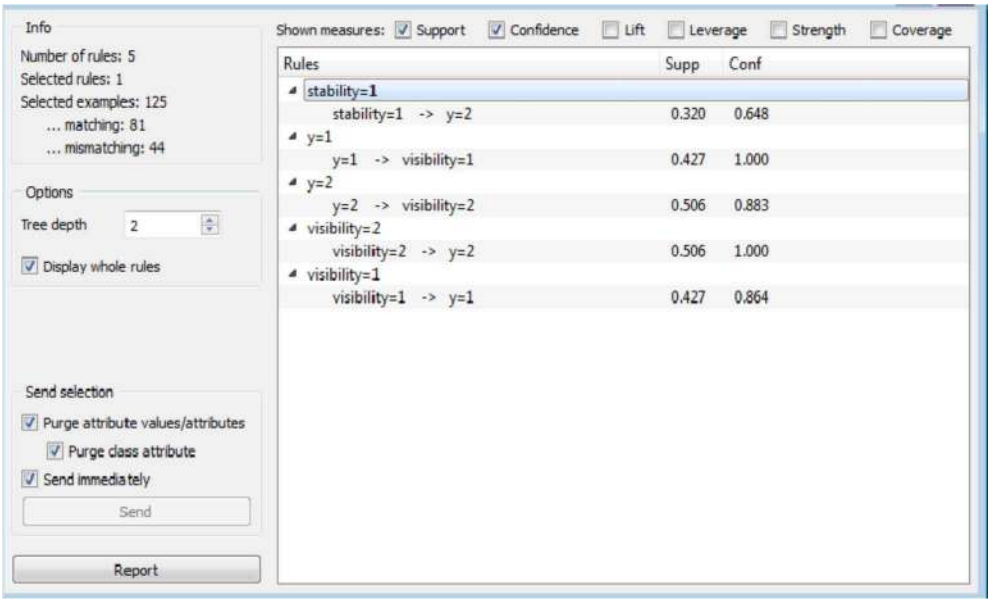


Figure 3: Overview of association rules

For each association rule there are quality measures shown: support and confidence. The first association rule has been highlighted. It can be seen that from 125 selected examples, 81 data examples do not match with first association rule. Further it can be seen that 44 examples do not match with gained association rule.

3. DISCUSSION

There are five association rules:

1. If attribute stability has numerical value 1, than it follows that iteration belongs to class Y 2, which is marked with landing confirmation, with support of 0.320 and confidence of 0.684.
2. If an iteration belongs to class Y 1 (landing rejection), than visibility has been marked with numerical value 1, with support of 0.427 and confidence of 1000.
3. If an iteration belongs to class Y 2 (landing confirmation), than it follows that visibility belongs to numerical value 2, with support of 0.506 and confidence of 0.883.
4. If visibility is marked with numerical value 2, than it follows that iteration belongs to Y 2, than it is recommended to land (confirmation), with support of 0.506 and confidence of 1000.
5. If visibility is marked with numerical value 1, than iteration belongs to class Y 1, as rejection for landing the aircraft, with support of 0.427 and confidence of 0.854.

Analyses of gained association rules have shown that rules number 2 and number 4 have biggest values of quality measures of confidence. It is determined that these two rules have biggest possibility to belong to certain class (for rule number 2 it is class Y 1, and for rule number 4 it is class Y 2). Analyses of support have shown that rules number 3 and number 4 have biggest possibility to fulfill conditions from the IF –part of the rule. Biggest possibility is that attribute belongs to class that is confirmed for landing (rule number 3) and that visibility has been marked with numerical value 2 (association rule number 4).

Based on the practical application of association rules it is determined that there is potential and confidence in calculations with parameters for more precise determination if landing conditions are suitable or not. Significance of gained results is obvious in the possibility of systematic overview of conditions in air traffic and based on that getting appropriate decisions on landing that were helped by this tool of business intelligence.

4. CONCLUSION

Presented model of decision making is helped by the methods of business intelligence of tool of an open-code software Orange has shown application in high effectiveness and accuracy in real-term settings of air traffic. It is recommended to further research and apply the model in the field of air traffic because this field has big potential and it is still relatively unresearched area. Model can be tested and developed in other similar fields of interest. In industry accent is on practical application of sustainable business development. For instance: evaluation of working of cars and conditions for driving; evaluation of various machines in factories; education of managers. In Academia the application of model can be used for the improvement at different levels of studies; use of case studies in the laboratories; students' education and the use of their knowledge and skills for different kinds of application and creation of new model. In public institutions the use of this model can be in Civil Aviation Directorate, also in different agencies for market analysis, etc. Civil society can use the model for personal non-commercial purposes for the research and application of model, in order to gain knowledge and education.

REFERENCES

Adamo, J. M. (2012). *Data mining for association rules and sequential patterns: sequential and parallel algorithms.* Springer Science & Business Media.

Altuntas, S., Dereli, T., & Kusiak, A. (2015). Analysis of patent documents with weighted association rules. *Technological Forecasting and Social Change, 92*, 249-262.

Anderson, D., Sweeney, D., Williams, T., Camm, J., & Cochran, J. (2015). *An introduction to management science: quantitative approaches to decision making.* Cengage Learning.

Ayub, A., Razzaq, A., Aslam, M. S., & Iftekhar, H. (2013). A conceptual framework on evaluating SWOT analysis as the mediator in strategic marketing planning through marketing intelligence. *European Journal of Business and Social Sciences, 2(1)*, 91-98.

Bazerman, M., & Moore, D. A. (2012). *Judgment in managerial decision making.*

Ding, S., He, X., & Liang, H. (2015, August). A Comprehensive Evaluation System of Association Rules Based on Multi-index. In 2015 *14th International Symposium on Distributed Computing and Applications for Business Engineering and Science (DCABES)* , 304-307. IEEE.

Fan, W., & Bifet, A. (2013). Mining big data: current status, and forecast to the future. *ACM sIGKDD Explorations Newsletter, 14(2),* 1-5.

Howson, C., & Hammond, M. (2014). *Successful Business Intelligence: Unlock the Value of BI & Big Data.* McGraw-Hill Education.

Humphrey, A. S. (2005). *SWOT analysis.*

Hwang, H., & Yoo, K. (2013). Mining Association Rules from the Web Access Log of an Online News website. *Journal of the Korea Industrial Information System Society, 18(2),* 47-57.

Nguyen, D., Vo, B., & Le, B. (2014). Efficient strategies for parallel mining class association rules. *Expert Systems with Applications, 41(10)*, 4716-4729.

Pettigrew, A. M. (2014). *The politics of organizational decision-making*. Routledge.

Power, D. J., Sharda, R., & Burstein, F. (2015). *Decision support systems*. John Wiley & Sons, Ltd.

Rouhani, S., Ashrafi, A., Zare, A., & Afshari, S. (2016). The impact model of business intelligence on decision support and organizational benefits. *Journal of Enterprise Information Management, 29(1).*

Ruiz, M. D., Gómez-Romero, J., Martin-Bautista, M. J., Sánchez, D., Vila, M. A., & Delgado, M. (2015). *Fuzzy Meta-Association Rules.*

Sauter, V. L. (2014). *Decision support systems for business intelligence*. John Wiley & Sons.

Simovici, D. A., & Djeraba, C. (2014). Frequent Item Sets and Association Rules. *In Mathematical Tools for Data Mining,* 647-668. Springer London.

Suknović, M., & Delibašić, B. (2010). *Poslovna inteligencija i sistemi za podršku odlučivanju*. FON, Beograd. In Serbian.

Suknović, M. (2001). *Razvoj metodologije podrške grupnom odlučivanju*. Doktorska disertacija, Fakultet organizacionih nauka, Beograd. In Serbian

Zhang, A., Shi, W., & Webb, G. I. (2016). Mining significant association rules from uncertain data. *Data Mining and Knowledge Discovery*, 1-36.

PREDICTING RISK OF BUYING LOW QUALITY CAR WITH RAPID MINER

Nemanja Mitic[1], Ana Jankovic[1], Milan Vukicevic[1]
[1]Faculty of Organizational Sciences University of Belgrade, Belgrade, Serbia
Corresponding author, Milan Vukicevic e-mail:vukicevicm@fon.bg.ac.rs

Abstract:*In this research, we build and evaluate several models for prediction of risk of buying alow quality used car. Highly accurate predictive model can serve as a decision support for car resellers and private users. Data is provided from the Kaggle.com challenge "Don't Get Kicked" hosted by Carvana.We followed CRISP-DM methodology for building and evaluation of predictive models. Special attention was given to automatic feature selection and algorithm parameter optimization.Complete experimental evaluation is conducted in Rapid Miner – one of the most popular open source Data Science environments.*

Keywords*:Car buying, Predictive modeling, Rapid Miner, CRISP-DM, Feature selection, Parameter optimization*

1. INTRODUCTION

One of the biggest challenges today is to find right product with good quality that fits all our needs. This problem becomes greater when aproduct that we want to buy is already used. In nowadays car market of used automobiles is very rich. And when we go to theauto dealership with the intent to buy a car, we want to make a good selection and to be able to trust the condition of the car that we want to buy. The output of this buying is agreat risk that the vehicle might have serious issues like mechanical issues, tampered odometers etc. The auto community calls these unfortunate purchases "kicks".

In this paper, we are building models that can predict and quantify the risk of buying a car that has low quality. We based our work on CRISP-DM methodology. CRISP-DM methodology is Cross Industry Standard that addressed parts of problems by defining a process model which provides a framework for carrying out data mining projects which are independent of both the industry sector and the technology used.(Wirth andHipp, 2000). Using this methodologywe have followed next steps:

- Business understanding
- Data understanding
- Data preparation
- Modeling
- Evaluation
- Deployment

Every phase of this process is important but crucial steps are business and data understanding and preparation of data which took most of the time in our process. We used Rapid Miner for creating our model. Rapid Miner is a software platform developed by the company of the same name that provides an integrated environment for machine learning, data mining, text mining, predictive analytics and business analytics.(Hofmann andKlinkenberg, 2013).RapidMinerwas used for building several processes for automatic building and evaluation of the models, but also feature selection and algorithm parameter optimization. Our main goal was to investigate theperformance of single and ensemble predictive models and to try to further improve them with feature and sample selection techniques. Winner of this competition focused his efforts on feature construction and building of different ensemble models, that are mostly based on LogitBoost and Decision stump models. These algorithms are evaluated in this research. However, we couldn't make a direct comparison with the winner of Kaggle competition, since the exact experimental setting is not published. Some details of winning model can be found in following the blog: http://blog.kaggle.com/2012/02/06/kicking-goals-an-interview-with-marcin-pionnier-of-the-winning-team-in-dont-get-kicked/.

2. DATA UNDERSTANDING AND PREPARATION

Our first major challenge was the preprocessing of data. We obtained our data set from the Kaggle.com challenge "Don't Get Kicked" hosted by Carvana(https://www.kaggle.com/c/DontGetKicked/data). The dataset contained 32 unique features with 72,983 samples along with a labeling of 0 for good car purchases

and 1 for "kicks".Some of themain attributes include odometer readings, selling prices, vehicle age and vehicle model.

We observed that output class was highly imbalanced8976 (12%) cases were labeled with 1 (badbuys) while 64007 (88%) cases were labeled with 0 (good buys). Figure 1 shows a number of good and bad buys (y-axis) over different car ages (x-axis). It can be seen that the best selling cars are aged between 2 and 6 years. Additionally, we can see that larger percentage of bad buys occur for older vehicles.

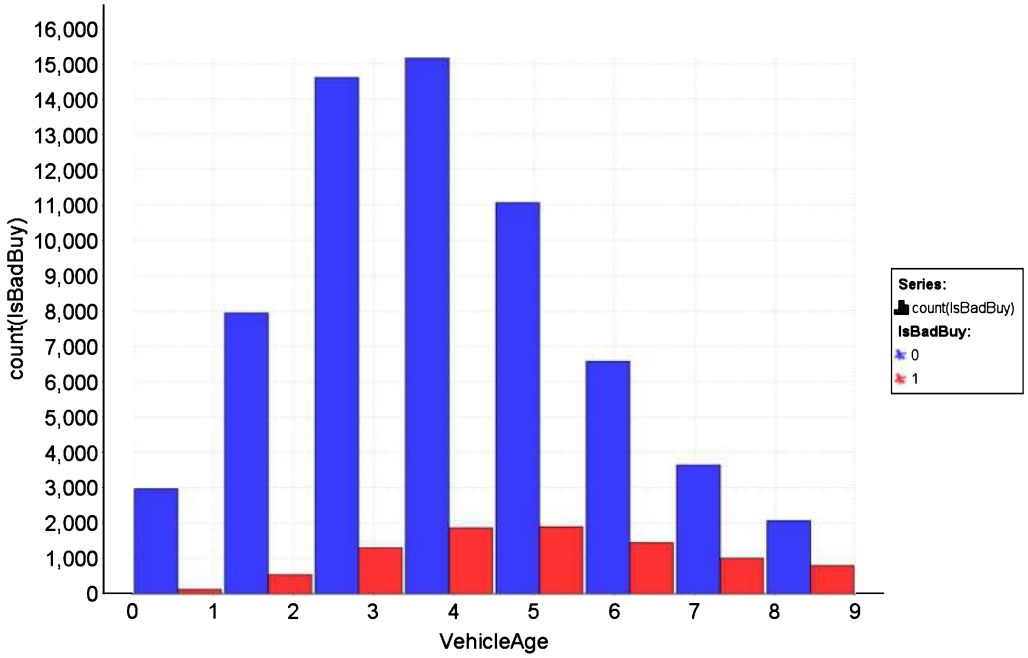


Figure 1: Histogram of good and bad buys over vehicle age

Further, we wanted to investigate theimportance of input features for predicting theoutput.For that purpose, we used three feature weighting techniques available in RapidMiner: Weight by Information Gain, Weight by Information Gain Ratio and Weight by Gini index. Detailed inspection of the results showed that all three feature weighting techniques had a consensus about 5 least important features ("Purch date", "IsOnlineSale", "Transmission" , "Nationality" , "Auction" , "VNZIP 1" and "Colour"). This is expected result since these features should not have relation with the car quality. Training data contain 2,674 missing values. Something we have observed immediately is that "good cars" are the most common in this set of data and make 87,7% of the examples and thus we replaced missing with average values. However, we acknowledge that some other type of imputation could lead to better predictive results.

3. MODELING

In this section, we briefly describe predictive models and feature selection techniques used in this research.

3.1. Naïve Bayes

The Naive Bayesian learning uses Bayes theorem with "Naive" assumption of independence between predictors (Russell and Norvig, 2003). Examples are classified based on the posterior probability that an example should be assigned to class.Even though independence assumption is violated in most real world applications, Naive Bayes often demonstrated satisfactory performance in practice (Rish, 2001), and was classified as one of the top 10 algorithms in data mining (Wolfson et al., 2014). Additionally, Naive Bayes models are easy to construct, without any setting or adjusting of complex parameters, computational and time effectiveness. Naive Bayes have the ability to work with large datasets (big data) and provide good interpretability (Hand and Yu, 2001).

3.2. Decision trees

Decision trees (DT) are predictive algorithms based on “greedy”, top-down recursive partitioning of data. DT algorithms perform an exhaustive search over all possible splits in every recursive step. The attribute (predictor) demonstrating the best split by some evaluation measure is selected for branching the tree. Regularly used are information theoretic measures (e.g. Information Gain, Gain Ratio, Gini etc.) or statistical tests quantifying the significance of the association between predictors and class. The procedure is recursively iterated until a stop criterion is met. Greedy strategy for DT building is often criticized, but the ability to build straight forward and the highly interpretable rules on massive data led to many successful applications in medical applications (Chao et al., 2014; Ting et al., 2014). They are also attractive classifiers due to their high execution speed. However, trees derived with traditional methods often cannot be grown to arbitrary complexity for the possible loss of generalization accuracy on unseen data. The limitation on complexity usually means suboptimal accuracy on training data. The essence of this method is to build multiple trees in randomly selected subspaces realize their classification in complimentary ways, and their combined classification can be monotonically improved (Ho,1995). This finding was used for efficient ensemble algorithms that will be described in the further text.

3.3. Ensemble algorithms

Ensemble algorithms combine multiple models in order to provide more accurate or more stable predictions. Ensemble models can aggregate the same model that is built on different subsamples of data, different models built on the same sample or a combination of the previous two techniques. Ensemble methods are often used to improve the individual performance of algorithms that constitute ensembles (Kuncheva and Whitaker, 2003) by exploiting the diversity among the models produced.

3.4.Random Forest

Random Forest (RF) is an ensemble classifier that evaluates multiple decision trees and aggregates their results, by majority voting, in order to classify an example (Breiman, 2001). There is a two level randomization in building these models. First, each tree is trained on a bootstrap sample of the training data and second, in each recursive iteration of building a DT (splitting data based on information potential of features), a subset of features for evaluation is randomly selected. This strategy allows efficient model building, and despite its random nature often provides highly accurate predictive models. In this research, we grew and evaluated Random Forest (RF) with 10 trees (with the default parameters of Weka’s implementation of Random Forest).

Random forestsis a notion of the general technique of random decision forests that are an ensemble learning method for classification, regression,and other tasks, that operate by constructing a multitude of decision trees at training time and outputting the class that is the mode of the classes (classification) or mean prediction (regression) of the individual trees. Random decision forests correct for decision trees' habit of overfittingto their training set.(Hastie et al., 2008)

Random forests are a combination of tree predictors such that each tree depends on the values of a random vector sampled independently and with the same distribution for all trees in the forest. The generalization error for forests converges as to a limit as the number of trees in the forest becomes large. The generalization error of a forest of tree classifiers depends on the strength of the individual trees in the forest and the correlation between them (Breiman, 2001).

3.5. Boosting

Boosting is an ensemble technique developed in order to improve supervised learning performance of weak learners (models whose predictive performance is only slightly better than random guessing). Boosting algorithms are built on a principle that subsequent classifiers are adapted to improve predictive performance on those instances that are misclassified by previous classifiers. In this research, we use Logit Boost (Friedman et al., 2000) technique and decision stump (weak learner) as suggested by thewinner of this competition.

3.6. Forward selection and backward elimination

The Forward Selection technique starts with an empty selection of attributes and, in each round, it adds each unused attribute of the given dataset. For each added attribute, the performance is estimated using the internal validation (usually cross-validation). Only the attribute giving the highest increase of performance is added to the selection. Then a new round is started with the modified selection. Backward elimination is using opposed strategy: it starts with all features and removes one by one until stop criteria are met.

4. EXPERIMENTAL EVALUATION

In our experiments, we wanted to compare the performance of several algorithms, and further to try to improve benchmark performance with algorithm parameter optimization, feature selection, and sample selection. RapidMiner process/sub-process structure and highly flexible process control, allowed us to define a process for automatic evaluation ofa number of algorithmsin one execution. Figure 2 shows one part ofthe automatic process. The upper part of the figure shows inner operators of “Validation” operator. “Validation” splits the data on training and test set (in our case 70% and 30% of the initial dataset). Further, In training part of “Validation” we used “Select sub-process” that allows iterative execution of a number of different algorithms (lower part of the figure). Finally, upper-right part of the figure shows part of testing, where models produced by the algorithms are applied and evaluated on the test set. This process also contained a procedure for decision tree optimization. We used grid optimization strategy that is available through “Optimize Parameters” operator. Decision Tree algorithm is optimized based on splitting criterion (gain ratio, information gain, gini index, accuracy) and stop criterion (maximal depth with possible values of 5,10,15,20,25, respectively).

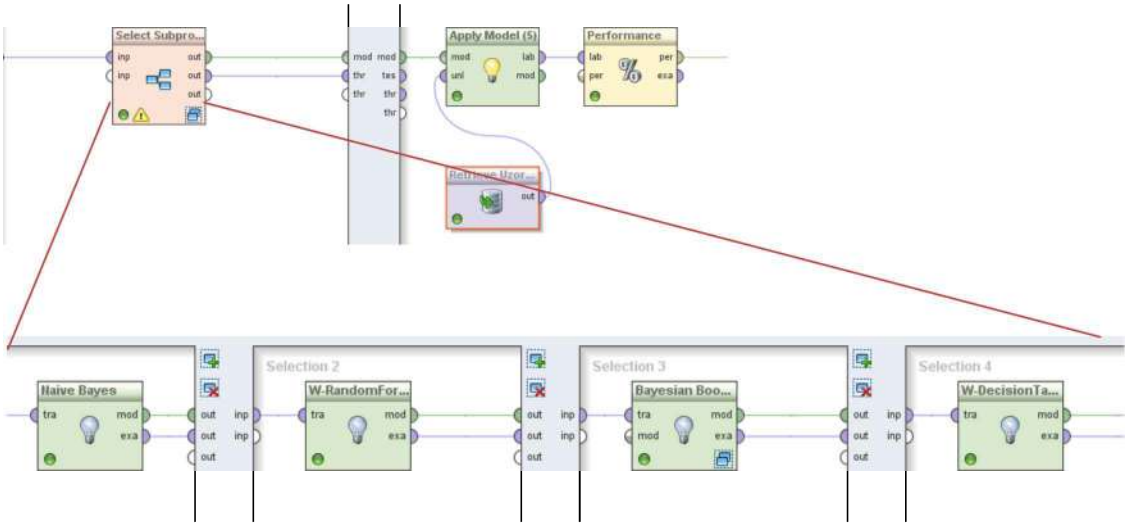


Figure 2: Process for automatic algorithm evaluation

4.1. Evaluation

All experiments are evaluated with three performance measures: Accuracy, F-measure, and Area Under Curve (AUC). Accuracy represents the percentage of testing set examples thatare correctly classified by the model. Even though this measure is frequently used in data mining research, it often results in misleading conclusions if it is not used along with some other evaluation measures. Namely, in the case of imbalanced output data, F-measure (also called F-score) is a measure of a test's accuracy. It considers both the precision p and the recall r of the test to compute the score: p is the number of correct positive results divided by the number of all positive results, and r is the number of correct positive results divided by the number of positive results that should have been returned. The F1 score can be interpreted as a weighted average of the precision and recall, where an F1 score reaches its best value at 1 and worst at 0.AUC is defined as the Area Under the Curve of the Receiver Operating Characteristics (ROC) and allows comparison of the general performance of binary classifiers, regardless of threshold selected for predictions. This is why it is often better for model evaluation than F-measure or Accuracy. Additionally, it does not give misleading results for imbalanced data.

4.2. Results

In the first part of the experiment, we evaluated benchmark models that are described in the previous section. Additionally, we also evaluated models that are built on balanced data. We undersampled majority class (leaving 6000 of positive samples and 12000 of negative samples) since this technique often leads to improvement of predictive performance of the models in cases of imbalanced data (He and Garcia, 2009). The results are showed in Table 1. On the left side of the table, we showed model performances for original and on the right side for balanced data. It is important to note that data balancing was conducted only on the training set. However, results show that performance by all evaluation measures and for all algorithms is decreased. This can be attributed to much smaller sample that was available with balanced data. t can be seen that best performance by all measures was achieved by Logit Boost (in both balanced and unbalanced cases). Further, decision tree (with and without optimization) showed the worst results. This is expected since it is widely known that these models have poor performance on imbalanced data.

Table 1: Performances of algorithm

Algorithm performance - training on unbalanced data				Algorithm performance - training on balanced data		
Algorithm	**AUC**	**Acc**	**f measure**	**AUC**	**Acc**	**f measure**
Naïve Bayes	0.682	0.751	0.848	0.680	0.699	0.807
Random Forest	0.696	0.874	0.931	0.663	0.785	0.874
Logit Boost	0.740	0.899	0.943	0.740	0.893	0.941
Decision Table	0.713	0.897	0.944	0.715	0.891	0.940
Decision tree	0.501	0.877	0.934	0.501	0.877	0.934
Decision tree (opt)	0.501	0.877	0.934	0.501	0.877	0.934

Additionally, it can be concluded from the results, that decision trees predicted only negative class since they had accuracy exactly the same as the percentage of the negative class in thetest set (and initial set). Since balancing the data showed adecrease in performance for all models, we excluded this dataset from further experiments.We additionally tried to improve thepredictive performance of our benchmark models by forward selection and backward elimination (described in theprevious section). The results are presented in Table 2.

Table 2: Results of algorithms using optimize selection

Algorithm performance –forward selection				Algorithm performance – backward elimination		
Algorithm	**AUC**	**Acc**	**f measure**	**AUC**	**Acc**	**f measure**
Naïve Bayes	0.658	0.885	0.937	0.751	0.711	0.808
Random Forest	0.658	0.885	0.937	0.751	0.792	0.895
Logit Boost	0.658	0.893	0.941	0.755	0.899	0.971
Decision Table	0.658	0.885	0.937	0.748	0.876	0.945
Decision tree	0.501	0.877	0.934	0.501	0.877	0.934
Decision tree (opt)	0.501	0.877	0.934	0.501	0.877	0.934

It can be seen that forward selection slightly decreased performance and backward elimination slightly increased theperformance of all models except decision tree.

5. CONCLUSION AND FUTURE RESEARCH

There has been a rapid growth of data mining in different application areas like business, healthcare etc.In this research, we exploited RapidMiner's possibilities for making flexible and automated process. We evaluated several single and ensemble predictive models and tried to improve their performance with feature selection, class balancing, and parameter optimization. In general, ensemble algorithms gave the best performance. Predictive performance on unseen cases is additionally improved by backward elimination procedure for feature selection. Undersampling of majority class did not give satisfactory results, most likely because of arelatively small sample of the data. In general, results obtained from presented experiments, show that they could be useful as a decision support for car buying. However, there is still a lot of room for further investigation and model improvement.

As a part of our future work, we plan to pay more attention to data pre-processing. We will try different sampling techniques (such as cluster sampling or systematic sampling), feature construction and selection techniques (i.e. PCA). Additionally, we will pay more attention to handling missing data. Finally, we will try to exploit more available ensemble algorithms as well as Support Vector Machines, Neural Networks etc.

REFERENCES

Breiman, L. (2001). Random forests. Machine learning, 45(1), 5-32

Chao CM, Yu YW, Cheng BW, &Kuo YL (2014). Construction the model on the breast cancer survival analysis use support vector machine, logistic regression and decision tree. *J Med Syst.* 38(10): 1–7.

Friedman, J., Hastie, T., &Tibshirani, R. (2000).Additive logistic regression: a statistical view of boosting (The annals of statistics, 28(2), 337-407.

Gupta, R andPathak, C. (2014), A Machine Learning Framework for Predicting Purchase by Online Customers based on Dynamic Pricing, Elsevier Science, 599-605.

Hand DJ, Yu K. (2001) Idiot's Bayes—not so stupid after all?*International Statistical Review*.69 (3): 385–398.

Ting H, Mai YT, Hsu HC, Wu HC, & Tseng MH (2014) Decision tree based diagnostic system for moderate to severe obstructive sleep apnea. *J Med Syst.* 38(9):1–10.

Hastie, T., Tibshirani, R., Friedman, J., & Franklin, J. (2005).The elements of statistical learning: data mining, inference, and prediction.The Mathematical Intelligencer, 27(2), 83-85.

He, H., & Garcia, E. A. (2009).Learning from imbalanced data. *Knowledge and Data Engineering, IEEE Transactions on*, *21*(9), 1263-1284.

Ho, A., Romano, R., & Wu, X. A. (2012).Don't Get Kicked-Machine Learning Predictions for Car Buying

Zhang H. (2004), The optimality of naive Bayes, AA, 1(2), 3

Hornick, M. F., Marcadé, E., &Venkayala, S. (2010). Java data mining: strategy, standard, and practice: a practical guide for architecture, design, and implementation. Morgan Kaufmann.

Hofmann, M., &Klinkenberg, R. (Eds.). (2013). RapidMiner: Data mining use cases and business analytics applications. CRC Press.

Kuncheva LI, Whitaker CJ (2003).Measures of diversity in classifier ensembles.*Machine Learning*.51: 181–207.

Rish I.An empirical study of the naive bayes classifier (2001)In: IJCAI 2001 Workshop on empirical methods in artificial intelligence; 41–66.Available: http://www.cc.gatech.edu/~isbell/reading/papers/Rish.pdf.

Russell S, Norvig P (2013). Artificial intelligence: a modern approach 2nd ed. Prentice Hall Series.

SameerchandPudaruth (2014), Predicting the Price of Used Cars using Machine Learning Techniques, International Journal of Information & Computation Technology, 4(7), 753-764.

Vipin Kumar (2014),Rapid Miner, Data mining use cases and business analytics applications,University of Minnesota, Department of Computer Science and Engineering Minneapolis, Minnesota, U.S.A.

Wah, Y. B., Ismail, N. H., & Fong, S. (2011). Predicting car purchase intent using data mining approach.In *Fuzzy Systems and Knowledge Discovery (FSKD)*, 2011 Eighth International Conference on (Vol. 3, pp. 1994-1999).IEEE.

Wolfson J, Bandyopadhyay S, Elidrisi M, Vazquez-Benitez G, Musgrove D, Adomavicius G, et al. (2014) A Naive Bayes machine learning approach to risk prediction using censored, time-to-event data. ARXIV [Internet]. 2014; Apr 8. Available: http://arxiv.org/abs/1404.2124.

PREDICTIVE MODELLING FOR CLAIMS PROCESSING – CASE STUDY OF BNP PARIBAS

Stefan Sreckovic[*1], Milija Suknovic[1], Milan Vukicevic[1]
[1]University of Belgrade, Faculty of Organizational Sciences
[*]Corresponding author, e-mail: vukicevicm@fon.bg.ac.rs

Abstract: *With the rising amount of business operations, claims management became an issue in insurance companies in order to process them accurately and fast at the same time. In this paper, a model is proposed for classifying new claim requests in BNP Paribas Cardif to ones that meet requirements for faster payments, and others that need some additional information before further processing. Training data set contained over 5000 instances, which represent claim requests, and more than 130 attributes. The data set was provided by www.kaggle.com as a part of 'BNP Paribas Cardif Claims Management' data mining contest. Using different algorithms, accuracy of 78.47% and AUC of 69.93% was achieved.*

Keywords*: predictive modeling, classification, insurance, claims management, ETL*

1. INTRODUCTION

BNP Paribas Cardif is a subsidiary of BNP Paribas Group based in France, which specializes in life and property insurance. It was founded more than 40 years ago and today operates in 36 countries while employing about 9000 people. Over 90 million people trusted BNP Paribas Cardif with insurance of their life and property, mainly in Europe, Asia and South America.

With the growing volume of business and rising amount of claims received, there is an issue of documentation processing speed required for the payment of insurance premiums. It is necessary to accurately process a lot of papers in a short period of time. With this in mind, people from BNP Paribas Cardif decided to set up their business problem to Kaggle platform in the hope of finding a model that will most accurately predict whether the claim contains a complete documentation so it can be processed faster or customers may need additional information before insurance company approves it.

The goal was to develop a model which precise predict the new claims requests, whether they are complete or not, depending on various attribute parameters. That model would speed up the claims management processes in an insurance company, reduce costs and would also allow the company to serve better customer experience to the customers and thus increase their satisfaction.

To develop a prediction model, software called RapidMiner was used, which is one of the leading freemium solutions on the market for predictive analytics. It supports the entire ETL (extract, transform, and load) process, pre-processing and visualization of data, statistical data processing, development of predictive models and much more. It supports various add-in extensions including Weka, R, Python and other which even more expand its possibilities.

2. STATE-OF-THE-ART

(Smith et al., 2000) were one of the first to publish a case study that involves data mining in the insurance industry. Their paper presents a case study involving two such problems and solves them using a variety of techniques within the methodology of data mining. The first of these problems was the understanding of customer retention patterns by classifying policyholders as likely to renew or terminate their policies. The second was better understanding claim patterns, and identifying types of policy holders who are more at risk. Each of these problems impacts on the decisions relating to premium pricing, which directly affects profitability. A data mining methodology was used which views the knowledge discovery process within a holistic framework utilizing hypothesis testing, statistics, clustering, decision trees, and neural networks at various stages. (Derrig and Ostaszewski,1995) have also provided an overview of fuzzy pattern recognition techniques in their paper and have used them in clustering for risk and claims classification

Some authors (Della Rocca, Johnson, 2010) were pointing out that increasing consistency in the claim-handling process not only improves policyholder satisfaction but also delivers measurable results to enhance

a carrier's bottom line. Advanced analytic technology and data-collection techniques can help an insurer settle similar claims in similar ways, leading to an adequate claim reserves, improved loss cost management, and more equitable settlements.

(Lentz, 2013) was pointing that some publications and vendors appear to promote predictive modeling as a way to automate decisions and allow a claim department to do more with fewer people. However, the principal goal of carriers using this technology is a better allocation of time and talent of claim professionals. Its purpose is to assist the claim professional through the course of a claim and provide supplemental information to be used in the decision-making process. While predictive modeling may enhance good claim handling, it cannot rectify poor claim handling. It is not a substitute for proper claim management methods and does not take the place of individual claim handling analysis.

(Rose, 2013) proposed that there are six areas where analytics can make a difference in claims management: fraud, subrogation, settlement, activity and litigation. He stated that adding analytics to the claims life cycle can deliver a measurable ROI with cost savings and that just a 1 percent improvement in the loss ratio for a $1 billion insurer is worth more than $7 million on the bottom line. (Derrig and Ostaszewski, 1995) have provided an overview of fuzzy pattern recognition techniques in their paper and have used them in clustering for risk and claims classification

Regarding fraud in claims management, it was discussed in many papers. (Phua et al., 2010) made a comprehensive survey that has explored almost all published fraud detection studies at the time, including claims. It was found that (Von Altrock, 1996) was able to achieve better claims fraud detection performances with his algorithms than the experienced auditors, while (NetMap, 2004) reported that visual analysis of insurance claims by the user helped discover the fraudster. (Huang, 1997) was using K-means algorithm for clustering large categorical data sets in his study and states that same technique can be used for detecting under-represented concepts like a fraud in a very large number of insurance claims (Ngai et al., 2011) made an exhaustive review of application of data mining techniques in financial fraud detection. (Sundarkumar and Ravi, 2015) proposed a novel technique for predictive modeling on imbalanced datasets in banking and insurance. This technique is based on under-sampling of training data with majority class. (Shi et al., 2015) proposed a series of multivariate negative binomial models for insurance claim counts.

(Frees and Valdez, 2008) were using negative binomial regression model for assessing claims frequency in automobile insurance records. Besides their second model was a multinomial logit to predict the event of a claim and severity component as a third one. When taken together, the integrated model was allowing more efficient prediction of automobile claims compared with than traditional methods. Using simulation, they demonstrated that by developing predictive distributions and calculating premiums under alternative coverage limitations.

A Towers Watson survey of Property and Casualty claim officers (Towers Watson, 2012) found that 63% of respondents have started to explore the use of predictive modeling in their claim operations. The survey further stated that 7% have already been using claim analytics for more than three years. (Lentz, 2013) proposed that the use of predictive modeling tools in claims is not meant to supplant the claim handler's own thought process; its purpose is to provide decision support for his or her individual analysis. As with other forecasting tools, predictive models indicate probabilities, not certainties.

At BNP Paribas Cardif Claims Management competition, training data set given to data analysts to create predictive classification models. (Lentz, 2013) was pointing that claim records with missing, incomplete, or erroneous data have a negative impact on the accuracy of the predictive model. As such, efforts to ensure clean and accurate data must be undertaken. This process may be long and costly for some insurers and more so for those with multiple legacy systems.

3. DATA

The data sets for this paper have been taken from the online predictive modeling and analytics competitions platform called Kaggle (https://www.kaggle.com/) and the theme was called "BNP Paribas Claims Management". Data sets are divided into training and test set. Training data had over 114.000 instances and 131 attributes. Besides them, there are two special attributes, ID or row number and Target, which represents output attribute or label with the values 0 and 1, where 0 means that claim documentation is not complete and thus needs further verification before payment, while 1 means that the claim documentation is complete and can be processed faster. There was a slight class imbalance, considering that there were 87 000 instances of class 1 and only 27.000 cases of class 0. In Figure 1 class distribution is shown.

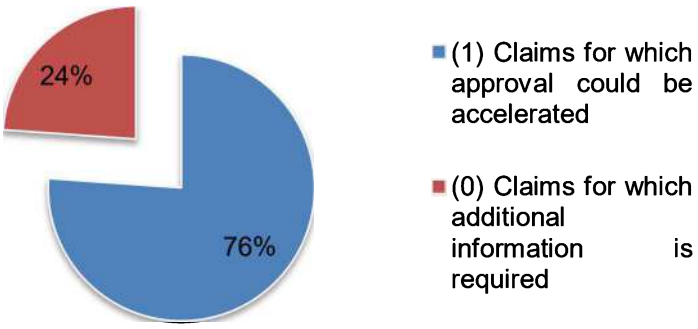


Figure 1: Class distribution

The attributes are of type integer, real or polynomial, which represent the vast majority. Also, attributes are unlabeled and marked with "v1, v2… v131" so I was denied of the meaning of each of them. On one hand, it prevents us to become more familiar with the data and eventually gather some insight of the problem, while on the other hand, compels us to focus on the very construction of the model predictions.

After loading the data, the first thing noticed was that there are a lot of missing values. Exactly 102 attributes have more than 40 percentage of missing values. As a result, almost 50.000 instances, or more than 40 percent of all user cases have around 70 percent of missing values. As the database contained over 100.000 instances and over 130 attributes, due to hardware limitation, experiments are conducted on 5.000 randomly sampled.

4. EXPERIMENTAL SETTING

In order to develop a highly accurate model for claim requests classification, we used the following predictive algorithms: Neural Net, Decision Tree, K-NN, W-Random Forest, Logistic Regression and Bayesian Boosting. Before the initial commissioning test, all the missing values were replaced with median values of attributes. It is important to note that other types of imputation techniques could be used for missing value imputation (i.e. model-based imputation) and possibly improve the final predictive performance of the models). Since we aimed to compare the performance of different predictive models and different feature selection techniques on a specific problem, detailed analyses of models for missing value imputation was out of the scope of this paper.

Polynomial attributes were converted to binominal given that Logistic Regression and Neural Net do not work with categorical values. Bearing this in mind, the attribute v22 was removed from further testing due to the fact that there are more than 17.000 categorical values and trying to convert its type to numerical or even binominal, each time the computer ran out of memory, the process froze and the operation could not be executed. Because of complexity and memory requirements of the algorithms (and optimization procedures) used in this research, original training set that contained 100.000 impressions, was reduced to 5.000 instances. In order to preserve distribution of the output class in the training set, stratified sampling technique was used.

In order to prevent overfitting that could be caused by extensive optimization of algorithm parameters and feature sets, inner validation has been used. Each model was trained on 70 percent of training data and validated on 30 percent. Finally, estimation of the future performance of optimized models was conducted on a complete test set that contained over 110.000 instances.

To measure the quality of selected models, I have decided to use accuracy and AUC. Accuracy as a measure represents the proportion of truly predicted cases over the entire data set. In this case, it is calculated as the sum of the number of predicted insurance claim requests that contain complete documentation which they truly do and the number of claims that do not have complete documentation which they truly don't, in relation to the number of the sum of all correct and incorrect predictions of a model.

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN}$$

The area under the curve, known as AUC, presents a measure of the discriminatory power of classifiers. It is very good for measuring performances of binary classifiers and it takes values from zero to one. When the value is above 0.5 it is a positive class prediction, and when is between 0.7 and 0.8 it is a good classifier, between 0.8 and 0.9 very good, and above 0.9, it is excellent.

5. RESULTS

A comparative review of the performance of the algorithms is shown in Table 1. Results are obtained through testing the model of the initial set and then adding weighting to the attributes with operators "Weight by Gini" and "Weight by SVM ".

Regarding the initial model, only necessary changes of obtained training data set were carried out, so that all algorithms work properly. All categorical attributes were converted into numerical because Neural Net and Logistic Regression do not work with categorical ones, the missing values have been replaced with average values of specific attributes and already mentioned attribute v22 was removed from the training set.

Best performance was achieved with Bayesian Boosting model. It is based on Bayesian theorem and it is used to improve the performance of other algorithms, in this case, W-Decision Table. The accuracy obtained with this model was 78.00%; however, the Neural Net and W-Random Forest were not far behind with 76.13% of accurate claims predictions.

Table 1: Initial performances of algorithms

	Initial model		Weight by Gini		Weight by SVM	
Algorithm	**AUC**	**Accuracy**	**AUC**	**Accuracy**	**AUC**	**Accuracy**
Neural Net	68.76%	76.13%	71.08%	76.13%	66.43%	76.67%
W-Random Forest	61.01%	76.13%	65.49%	76.47%	63.86%	76.13%
Bayesian Boosting - W Decision Table	69.91%	78.00%	69.93%	78.47%	68.93%	78.00%
K-NN Classification	50.00%	67.47%	50.00%	68.07%	50.00%	65.80%
Logistic Regression	69.63%	75.40%	68.17%	64.47%	69.90%	66.80%
Decision Tree	50.00%	75.73%	50.00%	76.00%	50.00%	75.93%

Additionally, we compared model performances in synergy with feature weighting and selection scheme. Weighting factors have been assigned to attributes via operator "Weight by Gini". After assigning weights, by the operator "Select by weight" I have influenced the selection of attributes which will be used in modeling algorithms.

The best performances were achieved by filtering the attributes that had normalized weight value greater than 0.26. Again, Bayesian Boosting algorithm gave the best results of all algorithms, and its performances were slightly increased compared to initial model: accuracy at 78.47% and AUC 69.93%. Other algorithms have also made a small progress in their performances, as it is shown in Table 1. The exception is Logistic regression which showed significantly poorer performance after this process.

By assigning weighting coefficients to the attributes using operator "Weight by SVM" and afterward filtering them, only Neural Net model showed improved accuracy (76.67%). However, AUC was only 66.43% comparing to satisfying 71.08% when the attributes were selected after weighting them using "Weight by Gini".

Further, parameter optimization is conducted. Starting from K-NN algorithm, k parameter and distance measure were optimized using validation so that model would not over fit. With values k=9 and using "Mixed measures" as distance measures to nearest neighbors, accuracy was 77.20% and Area under the curve was 66.07%, which is far better than the performance that I have got in previous interactions.

Optimizing Logistic regression and its parameter C, I have also been able to get better performance of the algorithm. In this case, accuracy was 77.20% while AUC was at 67.88%.

When it comes to Decision tree algorithm, by optimizing depth of the tree at 17, minimal gain at 0.03 with Gini index, criterion and turned off pruning option, results became much better. The accuracy of the model was 78.33% while the AUC was 67.54%, which is significantly better than the original 50.00% gained with the initial model parameter settings.

Table 2: Final performances of algorithms

Algorithm	AUC	Accuracy	Obtained by
Neural Net	71.08%	76.13%	Weight by SVM
W-Random Forest	65.49%	76.47%	Weight by Gini
Bayesian Boosting - W Decision Table	69.93%	78.47%	Weight by Gini
K-NN Classification	66.07%	77.20%	Optimize parameters
Logistic Regression	67.88%	77.20%	Optimize parameters
Decision Tree	67.54%	78.33%	Optimize parameters

Best performances by algorithms that have been obtained in this paper are shown in Table 2. By optimizing parameters of the algorithms, we were able to improve results compared to the initial model settings, especially with the Decision tree. Although all algorithms have approximately same performance, the Bayesian Boosting ensemble stands as the best algorithm outs with an accuracy of predicting new claim requests at BNP Paribas Cardif at 78.47%.

Predictive models for claims management that were obtained in this paper could be used by insurance organizations employees that deal with claims on daily basis in order to classify new requests; whether the claims payout process could be speed up, leading to higher customer satisfaction and cutting the costs of employees efforts analyzing requests, or the claims documentation should be revised. It could help employees make faster and more accurate decisions, leading to lower costs and higher efficiency.

6. CONCLUSION

In this research, we compared the predictive performance of several predictive models for classification of new claim requests in BNP Paribas Cardif. Development of accurate predictive model could serve as decision support for claims approval: weather approval could be accelerated, leading to faster payments, or it requires additional information before payout. Development of highly accurate predictive model could help the BNP Paribas Cardif insurance company to faster cultivate claims, reduce costs and increase the satisfaction of its clients. In order to improve predictive performance of the models, we conducted a number of experiments that include optimization of model parameters as well as feature sets. The results that were obtained in this research were satisfying, but there is certainly space for improvement. In our future work, we plan to conduct experiments on the larger training set, to investigate the performance of different methods for missing value imputation and to use advanced predictive methods like Support Vector Machines and Deep Learning based on Neural Networks.

REFERENCES

Della Rocca, R. & Johnson J. (2010). Advanced Claim Analytics and Data Mining. Retrieved April, 2016. from http://www.propertycasualty360.com/

Derrig, R. A., & Ostaszewski, K. M. (1995). Fuzzy techniques of pattern recognition in risk and claim classification. *Journal of Risk and Insurance*, 447-482.

Frees, E. W., & Valdez, E. A. (2008). Hierarchical insurance claims to model. *Journal of the American Statistical Association*, *103*(484), 1457-1469.

Huang, Z. (1997, May). A Fast Clustering Algorithm to Cluster Very Large Categorical Data Sets in Data Mining. In *DMKD* (p. 0).

Lentz, W. (2013). Predictive Modeling - An Overview of Analytics in Claims Management. Retrieved April 2016. from http:// http://media.genre.com/documents/ii1311-en.pdf

Ngai, E. W. T., Hu, Y., Wong, Y. H., Chen, Y., & Sun, X. (2011). The application of data mining techniques in financial fraud detection: A classification framework and an academic review of literature. *Decision Support Systems*, *50*(3), 559-569.

Netmap. (2004). Fraud and Crime Example Brochure.

Phua, C., Lee, V., Smith, K., & Gayler, R. (2010). A comprehensive survey of data mining-based fraud detection research. *arXiv preprint arXiv:1009.6119*.

Rose, S. (2013). Predictive Claims Processing: Transforming the Insurance Claims Life Cycle Using Analytics. Retrieved April, 2016. from http://www.sas.com

Shi, Peng, and Emiliano A. Valdez. "Multivariate negative binomial models for insurance claim counts." *Insurance: Mathematics and Economics* 55 (2014): 18-29.

Smith, K. A., Willis, R. J., & Brooks, M.. (2000). An Analysis of Customer Retention and Insurance Claim Patterns Using Data Mining: A Case Study. *The Journal of the Operational Research Society*, *51*(5), 532–541. http://doi.org/10.2307/254184

Sundarkumar, G. G., & Ravi, V. (2015). A novel hybrid undersampling method for mining unbalanced datasets in banking and insurance.*Engineering Applications of Artificial Intelligence*, *37*, 368-377.

Towers Watson (2012). Insights: Property & Casualty Claim Officer Survey.

Von Altrock, C. (1996). *Fuzzy logic and neurofuzzy applications in business and finance*. Prentice-Hall, Inc..

LOGICAL CLASSIFICATION METHOD FOR BANKRUPTCY PREDICTION

Ana Poledica*[1], Dragana Marković[1], Sanja Živančević[1]
[1]University of Belgrade, Faculty of Organizational Sciences,
*Corresponding author, e-mail: ana.poledica@fon.bg.ac.rs

Abstract: *The purpose of this paper is to introduce a novel logical classification (LC) method and further evaluate its application for bankruptcy prediction. Logical classification is based on nearest prototype classifier that employs a novel similarity measure and logical aggregation based on interpolative Boolean algebra (IBA). In this research logic-based classifiers are compared to Altman Z score as a benchmark model for bankruptcy prediction. Their classification performance is evaluated on Serbian middle-sized companies. The analysis shows that LC models are reasonable good classifiers and that they outperform Altman Z score.*

Keywords*: logical classification, similarity, IBA similarity measure, bankruptcy, company*

1. INTRODUCTION

Bankruptcy prediction is one of the main issues threatening many companies and governments. Bankruptcy is the inability of debt repayment to creditors. According to Chaudhuri (2013) financial distress begins when an organization is unable to meet its scheduled payments or when the projection of future cash flows points to an inability to meet the payments in near future. Chaudhuri (2013) also describes bankruptcy prediction as a complex process that consists of numerous inseparable factors. The causes leading to business failure and subsequent bankruptcy can be divided into economic, financial, neglect, fraud, disaster and others (Chaudhuri, 2013). With more accurate bankruptcy detection techniques, companies could take some preventive measures in order to minimize the risk of falling to bankruptcy.

Developing different methods for bankruptcy prediction is a popular subject among different authors who addressed the problem of finding the more accurate technique for this problem. There are two dominant approaches when it comes to predicting bankruptcy. The first one is based on statistical methods and was pioneered by Beaver (1966) and Altman (1968) who used multi-discriminant analysis. Beaver (1966) used univariate approach and found that net income to total debt had highest predictive ability. Olson (1980) and Zmijewski (1984) developed stochastic models such as logit and probit. As parametric models dominated the research focus at beginning, studies using non parametric models started to develop in late 1980s. Besides classical methodology many researchers have started introducing numerous alternative methods to predict bankruptcy. In the past decade, three important models namely Bayesian, Hazard and Mixed logit have been applied to bankruptcy prediction (Chaudhuri, 2013). According to Chaudhuri (2013) these models have subtle theoretical advantages over previous ones. He also points out that prior knowledge, practical estimates and subjective preferences are easy to incorporate into the model, either simultaneously or separately. The advantage of Hazard model over logit is that the former explicitly models bankruptcy not as process that happens at a point in time, an assumption made by all previous models, but as process that lasts for period of firm's life (Chaudhuri, 2013). Hazard model is preferable as it incorporates time varying covariates. The improvement of mixed logit model over logit is that it takes into account both observed information and unobserved information. Under this setting, there are two means to model unobserved information. Second approach utilizes artificial intelligence (AI) and adapts it for predicting bankruptcy. Min and Jeong (2009) described AI methods which include a decision tree, fuzzy set theory, case-based reasoning, genetic algorithm, support vector machine, data envelopment analysis, rough sets theory, and several kinds of neural networks such as BPNN (back propagation trained neural network), PNN (probabilistic neural networks), SOM (self-organizing map), Cascor (cascade correlation neural network). Kumar and Ravi (2007) has given an extensive review of bankruptcy prediction in banks and firms via statistical and intelligent techniques studies. Comparative analysis of data mining methods for bankruptcy prediction is given in (Olson, Delen, & Meng, 2012).

In many applications a good classifier should not only offer superior class predictions but also interpretation and understandability of the classification results. For instance, a manager wants to understand the characteristics of the situation that led to the decision proposed by the model (Kriegel, & Schubert, 2006). In this paper, we propose a novel similarity-based classifier - logical classification (LC). LC algorithm is based on the nearest prototype (centroid) classifier with a difference that it employs a similarity measure based on

interpolative Boolean algebra (IBA) (Radojević, 2000) and pseudo-logical aggregation (Radojević, 2008) for measuring similarities. The proposed classifier has strong mathematical background and is computationally efficient technique. It can also provide semantic information about classification results which is another important aspect of designing a classification algorithm. Further in the paper, the proposed logic-based classification approach is evaluated in bankruptcy prediction of Serbian middle-sized companies.

The paper is structured as follows. First of all, in Section 2 we present briefly theoretical concepts and methods used in this paper – Altman Z-Score model, IBA similarity measure and logical aggregation. In section 3 a novel logical classification method is presented. Further, Section 4 describes our company dataset and how the experiment is conducted. Here we also present and discuss results. In the final section we conclude the paper.

2. THEORETICAL BACKGROUND

2.1. Altman's Z-Score model

The first multivariate model for bankruptcy prediction of companies was Z-score (publicly traded firms) by Altman (1968). This model has proved to be the most efficient and has been in use for more than four decades. In determining the Z-score model it is necessary to divide sample into two groups, one group for bankrupt and the other for the non-bankrupt companies. For his research Altman divided 66 companies into two groups and used five out of 22 financial indicators for multivariate discriminant analysis. Altman (2000) found that the following five ratios provide the best results of Z-score model:

$$Z = 1.2X1 + 1.4X2 + 3.3X3 + 0.6X4 + 0.999X5 \quad (1)$$

Where:
X1 = Working Capital / Total Assets;
X2 = Retained Earnings / Total Assets;
X3 = EBIT (Earnings before Interest and Taxes) / Total assets
X4 = Market Value of Equity / Book Value of Total Liabilities
X5 = Sales / Total Assets

1) The Working capital/Total assets ratio (X1) is a measure of the net liquid assets of the companies relative to the total capitalization.
2) The Retained Earnings/Total assets ratio (X2) refers to the earned surplus of a company over its entire life.
3) The Earnings before interest and taxes/Total assets ratio (X3) is a measure of the true productivity or profitability of the assets of a firm. It is not affected by any tax or leverage factors. It reflects the earning power of the assets that determines the value of assets.
4) The Market value equity/Book value of total liabilities ratio (X4) shows how much the assets of a firm can decline in value (measured by market value of equity plus debt) before the liabilities exceed the assets and the firm becomes insolvent.
5) The Sales/Total Assets ratio is the standard capital-turnover ratio illustrating the sales generating ability of the assets of a firm. It refers to the capability of management in dealing with competitive conditions. This ratio was dropped in the Z"-Score model.

Altman's Z-score lower than 1.81 indicates that the company is heading for bankruptcy. Companies with scores above 2.99 are unlikely to enter bankruptcy. Scores between 1.81 and 2.99 mean that the company is in a gray area.

2.2. IBA similarity measure

Similarity between two objects is perceived differently when diverse similarity measures are applied (Poledica et al., 2015). From the standpoint of logic, similarity may be perceived by means of logical relations e.g. bi-implication and equivalence. In (Poledica et al., 2015; Poledica et al., 2013) IBA equivalence is introduced as a logic-based similarity measure where similarity is measured using [0,1]-valued realization of equivalence relation in interpolative Boolean algebra.

Interpolative Boolean algebra (Radojević, 2000) is [0,1]-valued realization of Boolean algebra (BA). It is a consistent framework in the sense it preserves all Boolean axioms (e.g. excluded middle, contradiction, etc.). In IBA logical Boolean functions are uniquely mapped to corresponding generalized Boolean polynomials

(GBP). Introducing intensity of relation, i.e. gradation of Boolean variables and functions, IBA is suitable for many real problems thanks to the descriptiveness of gradation.

When it comes to modeling similarity, logical relation of equivalence in its original form treats only two values: 0 and 1. However, human perception of similarity is rather graded. To calculate the degree of similarity between objects on the whole [0,1] interval, the GBP for logical expression of equivalence is first determined. Finally, its corresponding realization on the valued level is:

$$S_{IBA}(a,b)=1-b-a+2\cdot a\otimes b=1-b-a+2\cdot\min(a,b) \tag{2}$$

Radojević (2000) defined the mapping procedure of Boolean functions into GBPs, and the software support is provided in (Milošević et al., 2014).
In (Poledica et al., 2015; Poledica et al., 2013) it is also shown that the previous expression satisfies all properties for similarity measure: non-negativity, symmetry and limited range. In addition to strong mathematical background, IBA similarity measure is valuable from the aspect of interpretation. When comparing two objects it measures the degree to which a certain quality is present but also includes the degree of the absence of that quality as equally important. The graphical interpretation of similarity based on IBA equivalence is also provided in (Poledica et al., 2015). In Figure 1 $\min(a,b)$ describes how much two objects are the same with respect to a certain feature, and $1-a-b+\min(a,b)$ defines how much two objects are the same regarding the absence of that feature.

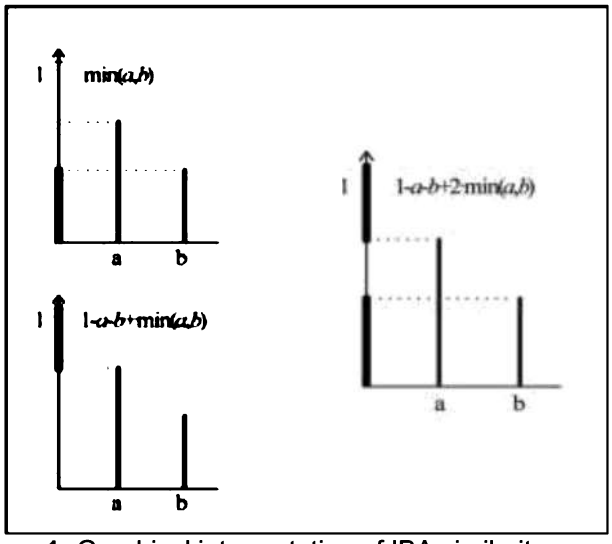


Figure 1: Graphical interpretation of IBA similarity measure

Additionally, similarities based on IBA equivalence may be further aggregated with logical aggregation (Radojević, 2008) which is also based on IBA.

2.2. Logical aggregation

Logical aggregation (LA) is a consistent and transparent procedure based on IBA for aggregating factors (Radojević, 2008). The main idea is to create aggregation functions in form of logical expressions which are used to aggregate primary/combined attributes into a single resulting value. It has two steps:

- Normalization of attributes' values:

$$\|\bullet\|:\Omega\rightarrow[0,1] \tag{3}$$

- Aggregation of normalized attributes' values into one resulting value by logical or pseudo-logical function used as a LA operator:

$$Aggr[0,1]^n\rightarrow[0,1] \tag{4}$$

Pseudo-logical function, called pseudo GBP, is a linear convex combination of generalized Boolean polynomials. Logical aggregation depends on choosing: the measure of aggregation (structural function of pseudo-logical function) and operator of generalized product. As a special case, LA operator can be expressed in form of other well-know aggregation operators such as weighted sum, arithmetic mean, min or

max function, discrete and generalized Choquet integral, etc. Logical dependence between aggregating factors may also be taken into account (Radojević, 2008). Being an expressive aggregation tool, LA is able to build various aggregation functions that depend on the nature of a problem (e.g. Milošević et al., 2013; Poledica et al., 2010).

3. LOGICAL CLASSIFICATION METHOD

In this paper, we propose a novel similarity-based classifier - logical classification (LC) method. It is based on nearest prototype (centroid) classifier in sense that it assigns to an instance the class of training set whose prototype is the closest to the instance. The proposed method is 'logical' as it employs logical relation of equivalence for measuring similarity. More precisely, multi-valued [0,1] realization of equivalence - IBA equivalence and LA tool are used to calculate similarities in the classification model. Thus, it is possible to build classifiers that provide semantic information about classification results.

Logical classification is a straightforward procedure and has the following steps:
- Scaling between [0,1] of training and test dataset
- Calculation of prototypes for every class
- Calculation of similarities between test set and prototypes
- Assigning class to test set

The problem is to classify dataset X into n different classes $C_1, C_2, ..., C_n$. Every data instance is described by different m attributes $a_1, a_2, ..., a_m$ that can be expressed or normalized in values between 0 and 1. This is a mandatory condition in IBA framework that is for IBA similarity and logical aggregation. Prototype vectors p_i for each class are represented by aggregated attributes for all instances in the training set of size dim.

$$p_i(a_1, a_2, ..., a_m) = \left(Agg_{j=1}^{\dim}(a_{1j}), Agg_{j=1}^{\dim}(a_{2j}), ..., Agg_{j=1}^{\dim}(a_{mj}) \right), \quad i = 1, ..., n \tag{5}$$

In this paper, to obtain attributes of prototype vectors for each class we used simple mean aggregation, as a special case of LA aggregation. Further, we calculate similarities of corresponding attributes for all instances of test data and prototype vectors by means of IBA similarity measure:

$$S_{IBA}(x, y) = Agg_{k=1}^{m}\left(1 - x(a_k) - y(a_k) + 2 * \min(x(a_k), y(a_k))\right), \quad x, y \in [0,1]^m \tag{6}$$

In the next step, based on maximum similarity between test instances and prototypes, test instances are assigned to appropriate class. Formally, if test instance $x \in C_n$ then:

$$S_{IBA}(x, p_n) = \max_{i=1...n} S_{IBA}(x, p_i) \tag{7}$$

In the algorithmic form LC classifier is as follows:

```
Algorithm: Logical classification
      input: trainData and testData with i=1…n classes,
             size of testData d,
      output: class
begin
1  scale trainData between [0,1]
2  scale testData between [0,1]

3  for i=1 to n do
4    p[i]=computePrototype(trainData[i])
5    similarity[i]=S_IBA^(j=1…d)(p[i],testData[j])
6  end

7  class=argmax_i similarity[i]
end
```

In this experiment we used different logical aggregation functions that are further presented:
- LC_1 classifier uses simple average as a special case of pseudo LA operator:

$$S_{IBA}(x,y)=\sum_{k=1}^{m}\left(1-x(a_k)-y(a_k)+2*\min\left(x(a_k),y(a_k)\right)\right) \quad (8)$$

- LC_2 classifier aims to include interaction in the data and uses common product for operator of generalized product in LA aggregation between all attributes:

$$S_{IBA}(x,y)=\prod_{k=1}^{m}\left(1-x(a_k)-y(a_k)+2*\min\left(x(a_k),y(a_k)\right)\right) \quad (9)$$

- LC_3 classifier is similar to LC_2 but attempts to treat similar nature in the data:

$$S_{IBA}(x,y)=S_{IBA}(x,y)_{1,2}\cdot\prod_{k=3}^{m}\left(1-x(a_k)-y(a_k)+2*\min\left(x(a_k),y(a_k)\right)\right) \quad (10)$$

where $S_{IBA}(x,y)_{1,2}$ is used to calculate similarities only for the first two (highly correlated) attributes in our data set. Minimum is applied for the generalized product in LA because these attributes are similar by nature.

$$S_{IBA}(x,y)_{1,2}=\min\left(1-x(a_1)-y(a_1)+2*\min\left(x(a_1),y(a_1)\right),1-x(a_2)-y(a_2)+2*\min\left(x(a_2),y(a_2)\right)\right) \quad (11)$$

4. EXPERIMENT AND RESULTS

4.1. Data and experiment

In the experiment we used a database provided from “CUBE Risk Management Solutions” a company that operates in the field of business information and credit risk services. The database contains financial data on 1020 middle-sized companies from Serbia. The companies are selected according to Accounting and Auditing Law ("Off. Gazette of RS", no. 46/2006, 111/2009 and 99/2011) which treats classification of legal entities in Serbia. The financial dataset include figures from annual financial statements balance sheet, income statement and statistical annex for 2014 and 2015. There are 984 companies which are active and 36 in the process of bankruptcy or liquidation. For each company we calculated five financial ratios used in Altman Z score model described in the second chapter (Eq. 1). The financial ratios for year 2014 are used as inputs in logical classification model. The predicted output is company status in year 2015: active or bankrupt.

In the experiment we compared Altman Z score as benchmark model with three LC models described in previous section: LC_1 (Eq. 8), LC_2 (Eq. 9) and LC_3 (Eq. 10, Eq. 11). The idea was to use the same ratios from linear Altman model as inputs in LC classifiers to test whether we can improve classification performance. The experiment was conducted on a non-balanced dataset.

To enable fair comparison of the models, it is important to consider various factors in the dataset that may have an effect on classification performance. In case of Altman's Z score model these factors are year of bankruptcy, company size, company age, industry and country of origin (Altman et al., 2014).

For his model Altman suggested utilizing data as near to the present as possible in order to develop more accurate bankruptcy prediction model. Also, significant impact on the performance of the model has size of companies. To eliminate this weakness, our analysis is focused only on middle-sized companies. Altman noticed that the age of the company may have an influence on bankruptcy risk. In particular, very young firms typically show a very high risk of failure. However we used middle-sized companies that are considered to be long-term and stable. Another important factor is country of origin. Different economic and culture factors, financial markets, legislation and accounting practices affect the financial behavior of companies. The Altman model is not adapted for Serbian economy.

In order to test the influence of data normalization to LC performance we scaled data on [0,1] interval using three standard normalization functions:

$$N_1=\frac{x+\min(X)}{\max\left(X+\min(X)\right)} \quad (12)$$

$$N_2=\frac{x}{\max(X)} \quad (13)$$

$$N_3 = \frac{x - \min(X)}{\max(X) - \min(X)} \tag{14}$$

where $x \in X$, and $\min(X)$ and $\max(X)$ represent minimum and maximum value of X, respectively.

In this paper, cross validation is used to evaluate the performance of the LC models. The cross validation was run 100 times. Each time data set was randomly portioned in two parts for training and testing 50-50 or 70-30. Slightly better results were achieved when we used 70% of data for training and 30% for testing.

4.2. Results and analysis

In this section we compare classification performance for Altman Z score and three LC models. For the dataset of Serbian middle-sized companies, Altman Z score achieved **73.24%** accuracy. In the following table (Table 1) classification results for LC models are presented, where all three LC models shows better accuracy than Altman benchmark model.

Table 1: Bankruptcy prediction results for LC classifiers

Normalization	LC_1		LC_2		LC_3	
	Accuracy	**Variance**	**Accuracy**	**Variance**	**Accuracy**	**Variance**
N_1	0.6999	0.0017	0.7126	0.0013	0.7239	0.0015
N_2	**0.7436**	0.0009	**0.7567**	0.0010	**0.7800**	0.0009
N_3	0.6959	0.0018	0.7002	0.0021	0.7226	0.0016

In Table 1 we can see that the best classification accuracy is achieved with normalization function N_2 (Eq. 13) for all three LC classifiers. Variance is very low for all three models and all normalization functions so we can conclude that LC models give quite stable results.

As expected the first LC1 model has the lowest accuracy, because it employs simple and linear classifier function (Eq. 8). LC2 model is developed to capture interaction in data by means of nonlinear aggregation function (Eq. 9). And the last LC3 model (Eq. 10, Eq. 11) aims to additionally include the same or similar nature of data, so that it shows the best accuracy.

The classification performance is also presented by confusion matrices in Figure 2 below. It is important to note that the results in confusion matrices are average values for 100 iterations. Confusion matrix consists of the accuracy (green fields) and error rates (red fields):

- TP true positive defines active (non-bankrupt) firms that are classified as active.
- TN true negative indicates bankrupt firms that are classified as bankrupt.
- FP false positive indicates bankrupt firms that are classified as active.
- FN false negative defines active firms that are classified as bankrupt.

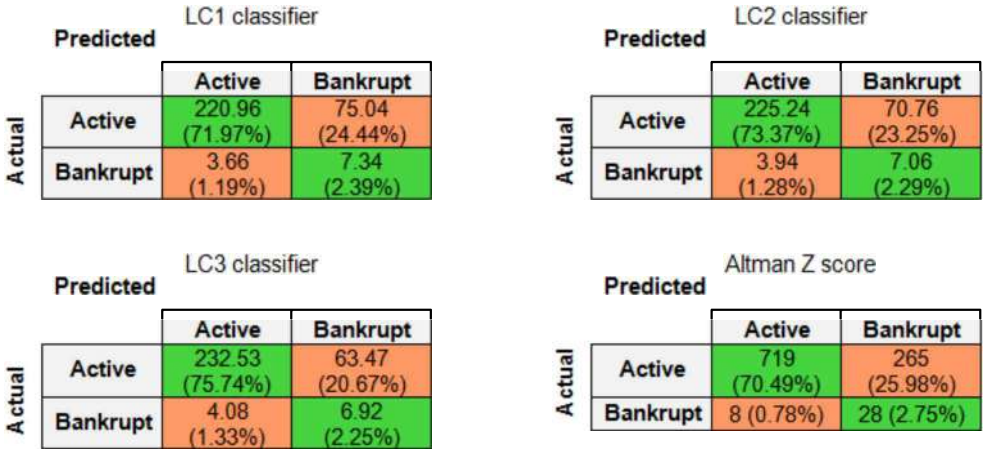


Figure 2: Confusion matrices for LC models and Altman Z score

When type I and type II errors are considered, LC classifiers have better error rates than Altman Z score for active firms that are classified as bankrupt but they provide somewhat worse error rates for bankrupt firms classified as active. Even though that difference is rather small, it can be indicator for further analysis and LC models improvement.

5. CONCLUSION

The aim of this paper is to propose new logical classifiers and evaluate their classification performance in bankruptcy prediction. Three LC models are tested whether they are able to improve Altman Z score as a benchmark model for bankruptcy prediction. In case of Serbian middle-sized companies LC classifiers outperformed Altman Z score. Even though LC method shows more accurate results, Altman model behaves slightly better for grey-zone companies, where it is important to reduce number of bankrupt firms identified as active. However there are still room left for improvement of LC model.

For further research, we suggest adding another class in the output that will identify these particular companies in pre-default state that are critical to fail in near future but still active. We also intend to consider additional variables that may help boost the classification performance to a higher level. One of the ideas is to analyze LC models on small-sized companies and try to identify other appropriate logical classifiers.

In a nutshell, the analysis in this study shows that LC model is reasonable good classifier for predicting company default. It is a rather stable classification model with low variance. In particular, LC method makes possible to understand the reasoning behind classifier function, which is important for decision making that is based on the classification models.

REFERENCES

Altman, E. I. (1968). Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *The journal of finance*, 23(4), 589-609. doi: 10.2307/2978933

Altman, E. I. (2000). Predicting financial distress of companies: revisiting the Z-score and ZETA models. *The journal of finance,* 9-12. doi: 10.4337/9780857936097.00027

Altman, E. I., Iwanicz-Drozdowska, M., Laitinen, E. K., & Suvas, A. (2014). Distressed Firm and Bankruptcy Prediction in an International Context: A Review and Empirical Analysis of Altman's Z-Score Model. *Journal of International Financial Management & Accounting,* doi: 10.1111/jifm.12053

Accounting and Auditing Law (2016). Retrieved from http://www.nbs.rs/.

Chaudhuri, A. (2013). Bankruptcy Prediction Using Bayesian, Hazard, Mixed Logit and Rough Bayesian Models: A Comparative Analysis. *Canadian Center of Science and Education*, 6(2), 1913-8989. doi:10.5539/cis.v6n2p103.

Du Jardin, P. (2010). Predicting bankruptcy using neural networks and other classification methods: The influence of variable selection techniques on model accuracy. *Neurocomputing*, 73(10), 2047-2060. doi: 10.1016/j.neucom.2009.11.034

Grice, J. S., & Ingram, R. W. (2001). Tests of the generalizability of Altman's bankruptcy prediction model. *Journal of Business Research*, 54(1), 53-61. doi: 10.1016/S0148-2963(00)00126-0

Jackson, H.G.R., Wood A.P. (2013). The performance of insolvency prediction and credit risk models in the UK: A comparative study. *The British Accounting Review* 45(3), 0890-8389. doi: 10.1016/j.bar.2013.06.009.

Kasgari, A. A., Divsalar, M., Javid, M. R., & Ebrahimian, S. J. (2013). Prediction of bankruptcy Iranian corporations through artificial neural network and Probit-based analyses. *Neural Computing and Applications*, 23(3-4), 927-936. doi: 10.1007/s00521-012-1017-z

Korol, T., & Korodi, A. (2011). An evaluation of effectiveness of fuzzy logic model in predicting the business bankruptcy. *Romanian Journal of Economic Forecasting*, 3(1), 92-107. Retrieved from http://www.ipe.ro/rjef/rjef3_11/rjef3_2011p92-107.pdf

Kriegel, H. P., & Schubert, M. (2006). Advanced Prototype Machines: Exploring Prototypes for Classification. *In SDM*, 176-187. doi: 10.1007/s10618-007-0067-9

Kumar, P. R., & Ravi, V. (2007). Bankruptcy prediction in banks and firms via statistical and intelligent techniques–A review. *European journal of operational research*, 180(1), 1-28. doi: 10.1016/j.ejor.2006.08.043

Milošević, P., Nešić, I., Poledica, A., Radojević, D. G., & Petrović, B. (2013). Models for ranking students: selecting applicants for a master of science studies. *In Soft computing applications* 93-103. doi: 10.1007/978-3-642-33941-7-11

Milošević, P., Petrović, B., Radojević, D., & Kovačević, D. (2014). A software tool for uncertainty modeling using Interpolative Boolean algebra. *Knowledge-Based Systems*, 62, 1-10. doi: 10.1016/j.knosys.2014.01.019

Min, J. H., & Jeong, C. (2009). A binary classification method for bankruptcy prediction. *Expert Systems with Applications*, 36(3), 5256-5263. doi: 10.1016/j.eswa.2008.06.073

Olson, D. L., Delen, D., & Meng, Y. (2012). Comparative analysis of data mining methods for bankruptcy prediction. *Decision Support Systems*, 52(2), 464-473. doi: 10.1016/j.dss.2011.10.007

Patouchas, A. (2010). The Art of Bankruptcy Prediction: a Review of Developed Methods. Aalto University School of Economics Department of Accounting and Finance. Helsinki, Finland.

Poledica, A., Bogojević-Arsić, V., & Petrović, B., (2010). Logical aggregation as similarity measure in case-based reasoning, *In Computational Intelligence Foundation and Application: Proceedings of the 9th International FLINS Conference, World Scientific Publishing Co.*, 585-590. doi: 10.1142/9789814324700_0088

Poledica, A., Milošević, P., Dragović, I., Radojević, D., & Petrović, B. (2013). A consensus model in group decision making based on interpolative boolean algebra. *In 8th conference of the European Society for Fuzzy Logic and Technology (EUSFLAT-13). Atlantis Press*, 32, 648-654 doi: 10.2991/eusflat.2013.98

Poledica, A., Milošević, P., Dragović, I., Petrović, B., & Radojević, D. (2015). Modeling consensus using logic-based similarity measures. *Soft Computing*, 19(11), 3209-3219. doi: 10.1007/s00500-014-1476-5

Radojević, D. (2000). (0,1)-valued logic: A natural generalization of Boolean logic. *Yugoslav Journal of Operations Research*, 10(2), 185-216. doi: 10.1016/j.eswa.2008.06.050

Radojević, D. (2008). Logical Aggregation Based on Interpolative Boolean Algebra. Mathware & Soft Computing,15(1),125-141.Retrieved from http://upcommons.upc.edu/bitstream/handle/2099/13098/22.pdf

Y., Gaunt C., Gray S. (2010). A comparison of alternative bankruptcy prediction models. *Journal of Contemporary Accounting and Economics*, 6(1),1815-5669. doi:10.1016/j.jcae.2010.04.002.

Zhou, L. (2013). Performance of corporate bankruptcy prediction models on imbalanced dataset: The effect of sampling methods. *Knowledge-Based Systems*, 41, 16-25. doi: 10.1016/j.knosys.2012.12.007

BUILDING A DATA-ENRICHED DEX-BASED DECISION SUPPORT SYSTEM FOR EARLY WARNING ON INCREASED RISK OF SKIING INJURY OCCURRENCE – FIRST RESULTS

Petar Marković*[1], Boris Delibašić[1], Milija Suknović[1]

[1]University of Belgrade, Faculty of organizational sciences, Serbia
*Corresponding author, e-mail: markovic26110mo@fon.bg.ac.rs

Abstract: *In this paper we present first results of building a decision support system for early warning on increased risk of skiing injury occurrence. We utilize the power of recently proposed DEX-based data-enriched modeling technique, showing that, on average, there is an evident supremacy of such models compared to the ones obtained using traditional data-mining and machine learning techniques in terms of prediction accuracy, consistency and interpretability. We argue the reason for such outcome lies in fact that traditional machine learning models are unable to explain the high variability in data, as it is known that skiing injuries are very rare events (only a 2.5 per mille of skier visits gets injured) and their spatio-temporal distribution in ski resort is very variable due to difference in skiing regions nature during different time periods (different popularity and difficulty of the slopes, weather conditions, skiing style of skiers, etc.) which also leads to high class imbalance problem. Thus, machine learning algorithms do not have enough data-based evidence to create strong rules for making a stable decision. On the other hand, traditional decision support systems, which are strictly expert-made, do not incorporate data-based knowledge within themselves. However, ski resorts safety experts are able to handle uncertainty and based on their experience recognize the patterns which lead to increased risk of injury, and express them in the form of a decision rule. Therefore, we effectively combine the best from both approaches to overcome this problem. For the purpose of this paper we used data from largest Serbian ski resort at Mt. Kopaonik from representative season 2010. Dataset was obtained through integration of three different data sources: weather data, ski lifts gates entrance data and injury records from the rescue service. The results are 22 location-specific models, plus 2 global models used for benchmark purposes. We compare the experimental results obtained with 7 most commonly machine learning algorithms used, tested on the same data with 10-fold cross-validation applied.*

Keywords*: DEX, decision support system, increased risk of ski injury, early warning, machine learning, Mt. Kopaonik ski resort*

1. INTRODUCTION

Skiing injuries are rare events. On average, only 2.5‰ of ski visits get injured (Conn et al, 2003). However, consequences of these events have strong impact both to skiers and ski resorts, as injuries are usually very severe which can generate high costs of medication (Warme et al, 1995). Report of Vanat (2014) states that the number of skiers around the world is around 400 million, which means that around 10,000 people gets injured, which makes skiing accidents prevention in ski resorts the topic of the utter importance on the global level (Nerin et al, 2007).

Until present, there were only a few papers which address this problem (Bohanec and Delibašić, 2015), (Dalipi et al, 2015), (Delibašić and Obradović, 2012).

This paper is an extension of recent paper of Bohanec and Delibašić (2015) which proposes a decision support system for skiing injury prediction using data-based knowledge and DEX decision support methodology. The methodology used in this paper is based on the same idea, but with major improvements on the modeling with respect to time and location. In original paper, the ski resort was observed as a whole, and the predictions were made on the daily level, which is in contrast to this paper, where the ski locations are modeled separately, and the time frame was a half of a skiing day.

Mt. Kopaonik is the largest Serbian ski resort. In the representative skiing season 2010, resort consisted of 14 skiing locations equipped with RFID ski gate scanners on lifts (SUN – Suncana dolina, MAR – Marine vode, DUB - Duboka, GOB - Gobelja, GVO - Gvozdac, JAR - Jaram, JEZ - Jezero, KAR - Karaman, KGB – Karaman Greben, KNE – Knezeve bare, MAK – Mali karaman , MAS - Masinac, PAN – Pancicev vrh, KRS - Krst).

Observing the integrated data from three different sources (ski gate entrance data, rescue service injury records and weather data) 11 locations were found eligible for further analysis, since KRS did not have any injuries recorded, whilst JAR had a 100% rate of injuries, and GVO had too few readings (Figures 1 and 2).

On average, on Mt. Kopaonik, injury rate is 1.5‰, which is in accordance with literature. Figure 1 shows that locations DUB, KGB, MAK, MAR are especially dangerous. On the other hand, figure 2 shows that the part of the day is an important factor for predicting injuries, as not all tracks are equally dangerous in the morning and in the afternoon. For example, GVO is much safer in the afternoon, as its percent of injuries drop from 78% in the morning to 57% in the afternoon.

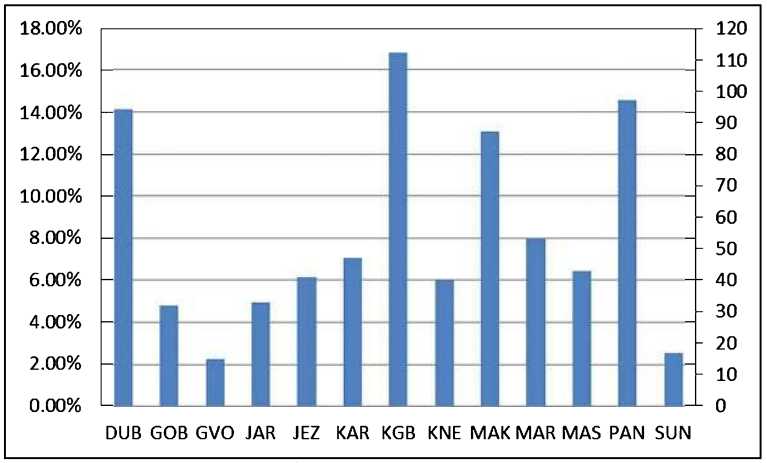


Figure 1: Distribution of skier days with at least one ski injury, per location (skiing region)

	before noon		before noon To	afternoon		afternoon Total
Row Labels	0	1		0	1	
SUN	33.33%	66.67%	50.00%	58.33%	41.67%	50.00%
MAR	60.61%	39.39%	50.00%	30.30%	69.70%	50.00%
DUB	71.23%	28.77%	49.66%	72.97%	27.03%	50.34%
GOB	78.26%	21.74%	54.76%	78.95%	21.05%	45.24%
GVO	21.43%	78.57%	66.67%	42.86%	57.14%	33.33%
JAR	0.00%	100.00%	68.57%	0.00%	100.00%	31.43%
JEZ	69.23%	30.77%	51.32%	45.95%	54.05%	48.68%
KAR	48.28%	51.72%	48.33%	16.13%	83.87%	51.67%
KGB	73.81%	26.19%	52.17%	74.03%	25.97%	47.83%
KNE	15.63%	84.38%	62.75%	21.05%	78.95%	37.25%
MAK	62.50%	37.50%	50.91%	62.96%	37.04%	49.09%
MAS	68.09%	31.91%	54.65%	48.72%	51.28%	45.35%
PAN	53.85%	46.15%	48.51%	65.22%	34.78%	51.49%
Grand Total	**57.82%**	**42.18%**	**52.42%**	**56.02%**	**43.98%**	**47.58%**

Figure 2: Relative distribution of skiing days with below-average (class label 0) and above-average (class label 1) number of injuries, per location and day period

2. METHODOLOGY

The core of methodology is based on previous research of Bohanec and Delibašić (2015) where data-enriched DEX-based decision support system was created for the ski resort as a whole, on the daily level. However, as our approach presumes independent location-time modeling, we adjusted the methodology so that attribute selection for each model is done separately, whilst the following steps are repeated iteratively for each of the models built. In short, the benefits of such modeling approach come from the fact that DEX models are transparent and consistent, whilst the knowledge which cannot be found in the data is complemented with the expert knowledge.

DEX models (Bohanec et al, 2013) represent a class of qualitative multi-criteria decision-making models. These models have hierarchical structure of attributes, where the attributes on the higher level of hierarchy are decomposed by set of attributes on the lower level. The attributes are defined using qualitative scales, ordered from the worst to the best values. Attributes on the lower level are aggregated to the higher level

attributes through utility functions (tables of elementary decision rules) where each combination of values of input (lower level) attributes are mapped to the corresponding value of the output (upper level) attribute. Consistency in model is achieved through presumption of utility function monotonicity, which means that for two combinations of non-decreasing input attributes' combinations, the consecutive output attribute value could not be lower than the previous. Thus, DEX model can be used as a classifier, as it actually represents a hierarchically ordered set of IF-THEN rules. For in-depth explanation on DEX models please consult the original reference.

The first step in methodology is discretization and attributes selection. This step is done in Orange data-mining software (Demšar, 2013), using interaction graphs. Interaction graphs (Jakulin, 2015) show which input attributes observed together, rather than separately, bring additional information for class determination. Therefore, the attributes with positive interaction values are good candidates for grouping, whilst ones with negative values should be disregarded from the model. Also, the attributes that do not have any information gain are excluded from the model. For the discretization sub-step, according to the previous paper of Bohanec and Delibašić (2015), 3-bins (low, medium, high) equal-frequency discretization was used, as it initially gave better results than the 5-bins version.

Second step is DEX modeling phase: attribute hierarchy creation, attribute scales determination based on relative frequencies observed in data, and definition of decision rules for utility functions. It is presumed that total ski injury risk can be decomposed into risk from crowding, risk from skiing style and risk from weather conditions. Therefore, in each model, the target attribute Total risk (on the first level of hierarchy) is decomposed into previously mentioned subgroups of attributes, which consist of belonging attributes selected in the previous step. When attribute hierarchy is created, the attribute scales for the elementary attributes (attributes on the lowest level of hierarchy) are defined by observing relative frequencies of class attribute in the data; whilst for the aggregate attributes the scales are always defined manually as H-M-L (as the lowest values of risk are the best in this case). The procedure is the same when determining decision rules for the aggregate attributes. Utility functions of aggregate attributes consisting of elementary attributes are defined by reading relative frequencies distributions of class attribute from data, whilst missing rules are defined by experts. On the other hand, utility functions of aggregate attributes consisting of other aggregate attributes are completely defined by experts (e.g. high risk of skiing style & high risk of crowding & high risk of weather conditions lead to high level of total risk of injury). In-detail explanation of attributes used is given in the following section.

Third and final step is Machine learning modeling phase where the machine learning models were created for the same groups of attributes used in the step one; 10-fold cross-validation was used. Classification tree, Logistic regression, Majority, CN2 rules, k-NN, SVM, Naïve Bayes classifiers were used, as they represent the most commonly used algorithms for this purpose. Due to space restrictions we skip detailed parameters settings.

3. EXPERIMENTAL SETUP AND MODELING

Original paper (Bohanec and Delibašić, 2015) presumed that all locations behave the same way, or in other words, it observed a ski resort in whole, and did not presume that different parts of the day have significant impact on levels of ski injury risk. However, observing the data from the representative skiing season (figures 1 and 2), we noticed that different locations have different injury rates at different period of day, thus we modeled them independently. This presumption was also proved when interaction graphs from the step 1 of methodology were created, which showed that not all attributes were important for predicting the injury on specific locations. Therefore, two types of models are created: location-specific models (represented as DEX in results), and global models (represented as DEX_all in results).

Due to space restrictions, we provide only a short preview of attributes (and their corresponding groups) used in models, whilst the true hierarchical structure between them is not presented. Figure 3 shows attributes used for the before noon models, whilst figure 4 shows attributes used for the afternoon models. There are three major groups of attributes: crowding-related, skiing-style-related and weather-related attributes.

Detailed explanation of each attribute is provided in the Table 1.

	Before noon	JEZ	MAS	SUN	PAN	DUB	KGB	KNE	MAK	GVO	MAR	KAR	GOB	JAR	DEX_all	SUM (w/o DEX_all)
crowding	noSkiers									/				/		8
	noRuns									/				/		9
	utilizationNorm									/				/		9
skiing	avgElevation									/				/		8
	avgTimeRun									/				/		4
	avgTimeSki									/				/		6
	minElevation									/				/		3
	minTimeRun									/				/		1
	minTimeSki									/				/		5
	maxElevation									/				/		3
	maxTimeRun									/				/		1
	maxTimeSki									/				/		5
	avgSpeedRun									/				/		8
weather	tempAvg									/				/		9
	tempMin									/				/		5
	tempMax									/				/		8
	cloudiness									/				/		5
	windSpeed									/				/		9
	snowNewCM									/				/		9
	geoAspect									/				/		0
	geoAspect2									/				/		0
	geoAspectNonBin									/				/		0
	geoAspectNonBin2									/				/		0
	SUM	12	13	9	11	11	5	11	9	/	12	11	11	/	19	

Figure 3: Attributes used for the morning models

On average, 11 attributes were needed for modeling. From figures 3 and 4 it is observable that in the afternoon, weather-related attributes and skiing-style-related attributes are more significant, compared to the before noon, where crowding-related attributes are more important. Both in the afternoon, and before noon, there are locations that can be modeled quite well with small number of attributes (such as KGB and DUB).

The number of attributes used potentially could be even smaller, if the data was more precise, as from the previous figures it is observable that some of the attributes in the same group are significantly less frequently used than the others, and probably are highly correlated to the most frequently used ones (e.g. minTimeRun, maxTimeRun, etc.).

	afternoon	JEZ	MAS	SUN	PAN	DUB	KGB	KNE	MAK	GVO	MAR	KAR	GOB	JAR	dex_all	sum (w/o dex_all)
crowding	noSkiers									/				/		8
	noRuns									/				/		5
	utilizationNorm									/				/		9
skiing	avgElevation									/				/		7
	avgTimeRun									/				/		5
	avgTimeSki									/				/		2
	minElevation									/				/		0
	minTimeRun									/				/		8
	minTimeSki									/				/		9
	maxElevation									/				/		4
	maxTimeRun									/				/		4
	maxTimeSki									/				/		5
	avgSpeedRun									/				/		7
weather	tempAvg									/				/		9
	tempMin									/				/		9
	tempMax									/				/		8
	cloudiness									/				/		9
	windSpeed									/				/		9
	snowNewCM									/				/		7
	geoAspect									/				/		0
	geoAspect2									/				/		0
	geoAspectNonBin									/				/		0
	geoAspectNonBin2									/				/		0
	sum	12	13	11	11	8	15	12	11	/	9	12	10	/	19	

Figure 4: Attributes used for the afternoon models

In table 1 we provide the detailed information on all attributes used. The attributes in italic are used for the modeling purpose.

Table 1: Explanation of attributes used

ID	Attribute group	Attribute	Description
1.	geo-spatial	date	
2.		region	
3.		dayPeriod	
4.	crowding	noSkiers	Number of skiers observed
5.		noRuns	Number of ski lift transportations observed
6.		utilizationNorm	Normalized ski lift capacity utilization
7.	skiing	avgElevation	Average height difference during skiing
8.		minElevation	Minimum height difference during skiing
9.		maxElevation	Maximum height difference during skiing
10.		avgTimeRun	Average time on slope (including lift transportation time)
11.		minTimeRun	Minimum time on slope (including lift transportation time)
12.		maxTimeRun	Maximum time on slope (including lift transportation time)
13.		avgTimeSki	Average time of skiing (without lift transportation time)
14.		minTimeSki	Minimum time of skiing (without lift transportation time)
15.		maxTimeSki	Maximum time of skiing (without lift transportation time)
16.		avgSpeedRun	Average skiing speed
17.	weather	tempAvg	Average daily temperature in ski resort
18.		tempMin	Minimum daily temperature in ski resort
19.		tempMax	Maximum daily temperature in ski resort
20.		cloudiness	Daily cloudiness level
21.		windspeed	Wind speed
22.		snowNewCM	Height of new snow in CM
23.		geoAspect	Impact of geographical aspect of slope, three categories
24.		geoAspect2	Impact of geographical aspect of slope (alternative), three categories
25.		geoAspectNonBin	Impact of geographical aspect of slope, two categories
26.		geoAspectNonBin2	Impact of geographical aspect of slope, two categories
27.	injury	injury	Absolute number of ski injuries per ski lift transportation
28.	injury	manyInjuries	If there is an above-average level of injuries takes value 1, otherwise 0

4. RESULTS

The classification accuracy was used as a main criterion of a model quality. The overall results are presented with two violin-plots in figures 5 and 6, respectively. Mean is marked with red dot, whilst the median is represented with white dot.

Figure 5 shows distribution of classification accuracy for the morning models. It is noticeable that mean values of location-specific model are much higher than other algorithms (Classification tree, Logistic regression, Majority, CN2 rules, k-NN, SVM, Naïve Bayes) and a-priori class probability. However, due to skewness of distributions it seems that median values are not so high, but still, for some of the locations such as KGB and DUB where it significantly dominated other models, and on the locations GOB and SUN was equal with the first-ranked algorithm. On other locations, on average, it was second-ranked with not very high difference in values of accuracy.

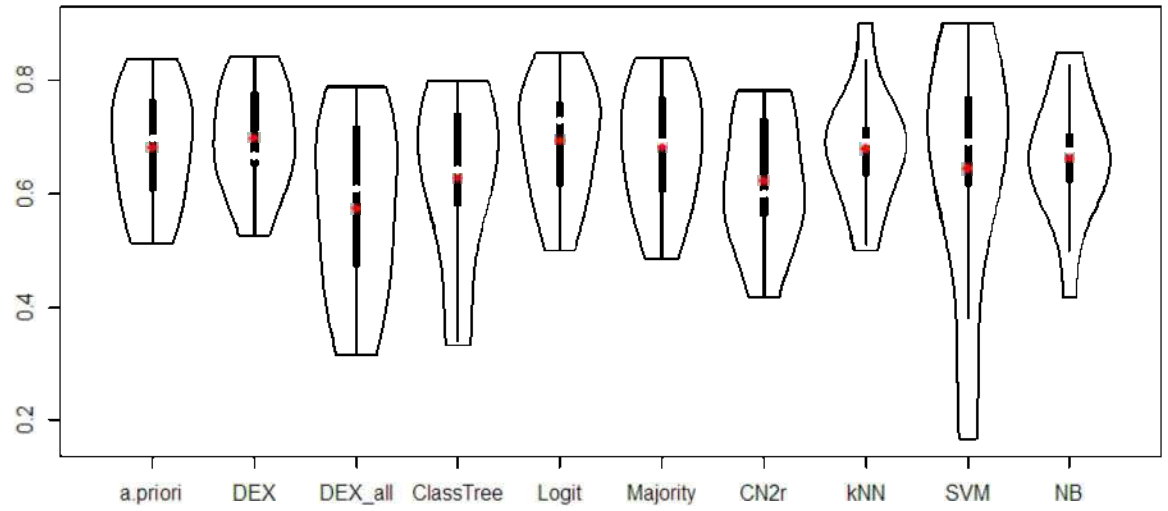


Figure 5: Violin plot of classification accuracy for the morning models

Figure 6 shows distribution of classification accuracy for the afternoon models. Here, the situation is even clearer than in the first part of the skiing day. We see that location-specific DEX model is superior to all others. Especially good results are achieved on locations SUN, MAR, MAK, MAS, PAN where our DEX model strongly outperformed other models.

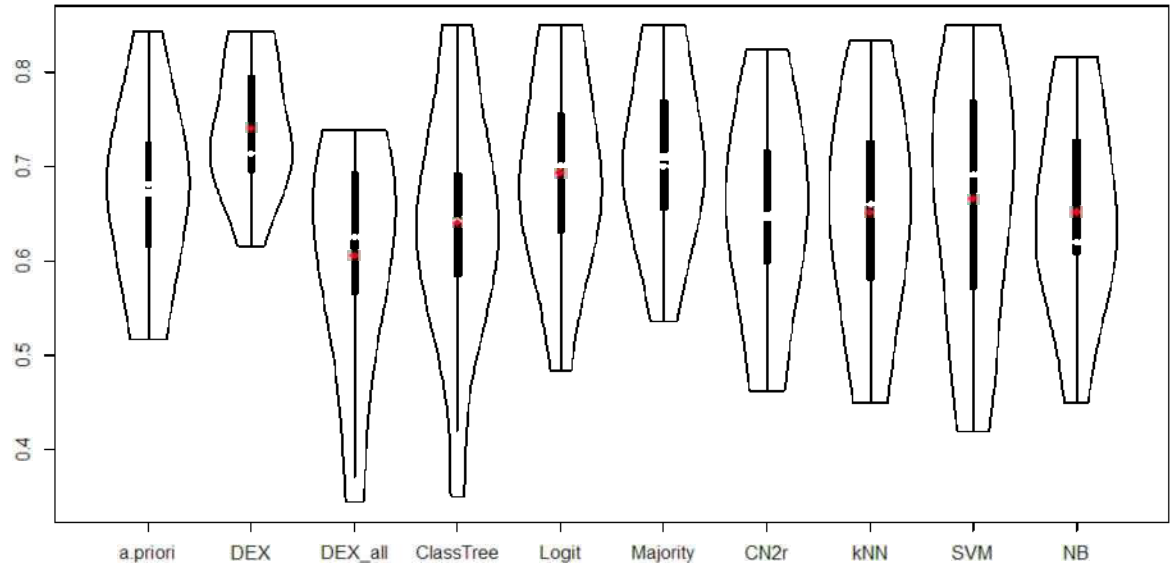


Figure 6: Violin plot of classification accuracy for the afternoon models

We conlude that our approach is major improvement to the previous research of Bohanec and Delibašić (2015) as DEX_all models showed much lower accuracy rates, both compared to location-specific DEX models, and other ML algorithms.

5. CONCLUSION

In this paper we created a near-real-time decision support system for early warning on skiing injury accident occurrence using recently proposed data-enriched DEX-based modeling approach.

The first results show that our approach, on average, reaches or outperforms traditional machine learning algorithms in terms of classification accuracy, whilst models obtained using proposed approach are consistent and easy to understand.

Further research should focus on adapting the methodology to fit the hourly time bins, which should finally lead to a real-time decision support system.

REFERENCES

Bohanec, M., Bratko, V., Rajkovič, I., Zupan, B., and Žnidaršić, M. "DEX methodology: three decades of qualitative multi-attribute modelling." *Informatica* 37 (2013): 49-54.

Bohanec, M. and Delibašić, B. "Data-mining and Expert Models for Predicting Injury Risk in Ski Resorts." ICDSST-*15, International Conference on Decision Support System Technology.* Belgrade, 2015.

Conn, J.M., J.L Annest, and J. Gilchrist. "Sports and recreaion related injury eposides in the US population 1997-99." *Injury Prevention* 9(2) (2003): 117-123.

Dalipi, Fisnik, and Sule Yildirim-Yayilgan. "The Impact of Environmental Factors to Skiing Injuries: Bayesian regularization Neural Network Model for Predicting Skiing Injuries." The 6th IEEE International Conference on Computing Communications and Networking Technologies. Dallas, USA, 2015.

Delibašić, B., and Obradović, Z. "Towards a DGSS Prototype for Early Warning for Ski Injuries." *Data Engineering Workshops (ICDEW), 2012 IEEE 28th international Conference on Data Engeneering Workshops.* Arlington, VA: IEEE, 2012. 68-72.

Demšar, J., and et al. "Orange: Data mining toolbox in Python." *Journal of Machine Learning research* 14 (2013): 2349-2353.

Jakulin, A. *Attribute interactions in Machine learning.* 2005. stat.columbia.edu/~jakulin/Int/ (accessed 9 17, 2015).

Nerin, M.A., P. Maza, P. Bada, and P. Garijo. "Safe Mountains: Ans Initiative of Prevention of Mountain Accidents in Central Pyrenees (Aragon, Spain)." *Wilderness & Environmental Medicine* 18 (2007): 235-250.

Vanat, L. *International Report on Snow & Mountain Tourism: Overview of the key industry figures for ski resorts.* 2014. http://www.isiaski.org/download/20140517_ISIA_Vuokatti_1b_presentation_vanat.pdf (last access date: 3.9.2015).

Warme, W.J., Jr.J.A. Feagin, and P. King. "Ski injury statistics, 1982 to 1993, Jackson Holes Ski Resort." *The American Journal of Sports Medicine* 23 (5) (1995): 597-600

EUROPE 2020 STRATEGY – A MULTIVARIATE APPROACH

Nemanja Milenković*[1], Aleksandar Đoković[1], Aleksandra Vukmirović[2]
[1]Faculty of Ogranizational Sciences, University of Belgrade
[2]Belgrade Business School, Higher education institution for applied studies
*Corresponding author, e-mail: milenkovic@fon.bg.ac.rs

Abstract: *In 2010 the European Union (EU) and Member States started a strategy for sustainable growth for the next ten years – the strategy "Europe 2020". Strategy is focused on three mutually reinforcing priorities: smart growth, sustainable growth and inclusive growth. It establishes five major goals for the EU: employment, research and development, climate change and sustainable energy, education and combating poverty and social exclusion. The European Commission has identified thirteen indicators divided into five groups based on which it will measure the success of the Europe 2020 Strategy. The I-distance method is applied on the above indicators. The aim of this paper has been to present one synthesized indicator that is able to quantitatively demonstrate any country's development. The I-distance method is thoroughly explained and has been applied to 28 EU countries. Crucial indicators for ranking are also elaborated.*

Keywords*: strategy Europe 2020, European Union, I-distance method, indicators, ranking*

1. INTRODUCTION

The global economic crisis has wiped out years of economic and social progress and pointed to the structural weaknesses of European economy. In 2010 the European Union (EU) and Member States started a strategy for sustainable growth for the next ten years – the strategy "Europe 2020". This strategy is a continuation of the Lisbon Strategy announced at the beginning of this century, which was aimed at improving conditions for sustainable economic development (Balcerzak, 2015). In contrast to the Lisbon Strategy, Europe 2020 Strategy does not any more insist on global competitiveness, but on the creation of a "new economy" to solve primarily European economic problems (Hoedl, 2011). It is dedicated to short-term challenges associated with the crisis, but also the need for structural reforms by means of measures to encourage the growth needed to prepare the EU for the future. The implementation of the strategy Europe 2020 takes place in a rather difficult and turbulent period marked by the particularly the negative impact of the global financial crisis, which significantly affected the further development of the project to build economic and monetary union in the European integration space (Terem et al., 2015).

The aim of the Europe 2020 Strategy is not only to overcome the crisis, but also to address the shortcomings of the existing model of growth and to create conditions for smart and sustainable growth and development. Europe 2020 Strategy is focused on three mutually reinforcing priorities (European Commission, 2010): smart growth (developing an economy based on knowledge and innovation), sustainable growth (promoting a more resource efficient, greener and more competitive economy) and inclusive growth (fostering a high-employment economy delivering social and territorial cohesion).

It establishes five major goals for the EU by the end of 2020. They include: employment, research and development, climate change and sustainable energy, education and combating poverty and social exclusion. The objectives of the strategy are supported by seven flagship initiatives (Innovation Union, Youth on the Move, A Digital Agenda for Europe, Resource efficient Europe, Industrial policy for the globalization era, Agenda for new skills and jobs, European platform against poverty). Together they provide a framework to enable the EU and regional centers to jointly strengthen efforts in areas that support the priorities of the Europe 2020 Strategy (Vuković 2011; Jakab and Alderslade, 2015).

The European Commission has identified thirteen indicators divided into the following five groups on the basis of which they will measure the achievements of the five main objectives:

1. Employment: (I) Employment rate (age group 20-64);
2. Research and development: (II) Gross domestic expenditure on R&D (% of GDP);
3. Climate change and energy: (III) Greenhouse gas emissions (in %, base year 1990), (IV) Share of renewable energy in gross final energy consumption (in %), (V) Primary energy consumption (in %, base year 2005), (VI) Final energy consumption (in %, base year 2005), (VII) Greenhouse gas emissions in non-ETS sectors (base year - 100 million tonnes CO2 equivalent);

4. Education: (VIII) Early leavers from education and training (% of the population aged 18-24), (IX) Tertiary educational attainment (age group 30-34);
5. Poverty and social exclusion: (X) People at risk of poverty or social exclusion (% of total population), (XI) People living in households with very low work intensity (% of total population aged less than 60), (XII) People at risk of poverty after social transfers (% of total population), (XIII) Severely materially deprived people (% of total population).

The advantage of this policy document resides in the fact that it has well-established indicators that enable measuring achievement, and thereby the possible success of the respective European policies (Bere et al., 2015). The aforementioned indicators are capable of expressing the diversities of countries and their performances.

The aim of this paper is to explore the current situation in the EU using these thirteen indicators. To this end we have used multivariate I-distance methodology to reduce the initial set of indicators and to extract and identify the most important indicators that will contribute to the achievement of the priorities and the main objectives of Europe 2020 Strategy.

2. THE I-DISTANCE METHOD

In order to create a synthesized development indicator, selected indicators are incorporated into the analysis through use of the statistical I-distance method. The analyses carried out using the statistical I–distance method are numerous. I–distance was applied in previous researches in order to evaluate the academic ranking of the world's universities (Jeremic et al., 2011; Jovanovic et al., 2012). It was also used for measuring European countries' health systems (Jeremic et al., 2012), sustainable development (Radojicic et al., 2012), public health (Seke et al., 2013) and ICT Development (Dobrota et al., 2012).

I-distance is a metric distance in an *n*-dimensional space. Ivanovic had originally devised this method to rank countries according to their level of development based on several indicators. Many socio-economic development indicators were considered and the problem was how to use all of them in order to calculate a single synthetic indicator, which would thereafter represent the rank (Ivanovic, 1973).

For a selected set of variables $X^T = (X_1, X_2, ..., X_k)$ chosen to characterize the entities, the I-distance between the two entities $e_r = (x_{1r}, x_{2r}, ..., x_{kr})$ and $e_s = (x_{1s}, x_{2s}, ..., x_{ks})$ is defined as

$$D(r,s) = \sum_{i=1}^{k} \frac{|d_i(r,s)|}{\sigma_i} \prod_{j=1}^{i-1} \left(1 - r_{ji.12...j-1}\right) \quad (1)$$

where $d_i(r,s)$ is the distance between the values of variable X_i for e_r and e_s e.g. the discriminate effect $d_i(r,s) = x_{ir} - x_{is}, i \in \{1,...,k\}, \sigma_i$ the standard deviation of X_i, and $r_{ji.12...j-1}$ is a partial coefficient of the correlation between X_i and X_j, $(j < i)$ (Ivanovic, 1977).

The construction of the I-distance is iterative; it is calculated through the following steps:

- Calculate the value of the discriminate effect of the variable X_1 (the most significant variable, that which provides the largest amount of information on the phenomena that are to be ranked,
- Add the value of the discriminate effect of X_2 which is not covered by X_1,
- Add the value of the discriminate effect of X_3 which is not covered by X_1 and X_2,
- Repeat the procedure for all variables.

Occasionally, it is not possible to achieve the same sign mark for all variables in all sets. As a result, a negative correlation coefficient and a negative coefficient of a partial correlation may occur. This makes the use of the square I-distance even more desirable. The square I-distance is given as

$$D^2(r,s) = \sum_{i=1}^{k} \frac{d_i^2(r,s)}{\sigma_i^2} \prod_{j=1}^{i-1} \left(1 - r_{ji.12...j-1}^2\right) \quad (2)$$

The entity with the minimal value for each indicator or a fictive maximal or average values entity can be set up as the referent entity. The ranking of entities in the set is based on the calculated distance from the referent entity (Ivanovic and Fanchette, 1973).

By using the calculated I^2-distance, the intensity of the observed phenomena and rank entities can be observed. When a correlation coefficient of each indicator with the I^2-distance is calculated with the ranking indicators of those values, the importance of each indicator can also be examined. As the correlation coefficient is stronger, the amount of information that is provided with the observed indicator is also greater, when the $p < 0.05$ indicator is significant. Otherwise, the indicator is not important in measuring the phenomena observed. One of two reasons might explain this: either this indicator is not relevant in measuring the phenomena observed, or its discriminate effect is already contained in previous variables. Whatever the reason, the indicator must be excluded from further analysis, since, in order to select only significant indicators, it is necessary to calculate the I^2-distance and its correlation with the indicators used several times, excluding the one insignificant indicator that has the smallest correlation coefficient (Milenkovic et al., 2014). Through use of the stepwise method, one indicator is eliminated in every calculation until the results show that all the indicators used are significant, whereupon the results are obtained.

3. RESULTS

The database used in this paper includes the values of the thirteen indicators for 28 countries of the EU. We used the data for the year 2014, since it is the last year for which all indicator values for specific countries in the EU exist. To implement I-distance methodology we used the statistical package SPSS version 22. The results achieved by the square I-distance ranking method in the first calculation for evaluating development are presented in Table 1.

Table 1. The results of the I^2-distance method, I^2-distance value, and rank – first calculation

Country	I^2-distance	Rank
Sweden	84.54	1
Estonia	49.42	2
Finland	41.09	3
Luxembourg	39.51	4
Malta	37.35	5
Austria	35.05	6
Czech Republic	32.55	7
Denmark	31.80	8
Lithuania	31.29	9
Netherlands	29.86	10
Germany	27.28	11
Latvia	30.34	12
Poland	28.72	13
Slovenia	25.74	14
France	24.06	15
United Kingdom	21.85	16
Cyprus	23.31	17
Slovakia	22.42	18
Romania	22.05	19
Belgium	18.76	20
Ireland	18.93	21
Hungary	15.97	22
Croatia	17.07	23
Portugal	13.52	24
Bulgaria	12.22	25
Spain	10.82	26
Greece	10.86	27
Italy	10.18	28

This data set was further examined and a correlation coefficient of each indicator with the I^2-distance value was determined. The results are presented in Table 2 (using the Pearson correlation test).

Table 2. The correlation between the I^2-distance and the initial indicators

Indicator	*r*
Severely materially deprived people	0.822**
Employment rate	0.695**
People living in households with very low work intensity	0.635**
People at risk of poverty or social exclusion	0.537**
Share of renewable energy in gross final energy consumption	0.529**
Primary energy consumption	0.519**
Gross domestic expenditure on R&D	0.466*
Final energy consumption	0.390*
Tertiary educational attainment	0.366
People at risk of poverty after social transfers	0.259
Greenhouse gas emissions in non-ETS sectors	0.135
Early leavers from education and training	0.115
Greenhouse gas emissions	0.039

The correlation coefficients between the I^2-distance and initial indicators demonstrate which indicators are important in analyzing a country's development. As has been noted above, the stepwise method excludes one insignificant indicator that possesses the smallest value of the correlation coefficient. Calculating the I^2-distance should be repeated stepwise until the results show that all selected indicators are statistically significant. In this case, the stepwise method eliminated those five indicators that were insignificant in the first calculation and the results achieved in the sixth calculation are those, which are final. The result need not include all indicators that had been significant in first calculation, but may include those indicators that had been insignificant in first calculation. The results are presented in the following tables.

Table 3. The results of the I^2-distance method, I^2-distance value, and rank – last calculation

Country	I^2-distance	Rank
Sweden	69.54	1
Estonia	47.18	2
Malta	38.04	3
Finland	35.33	4
Luxembourg	30.93	5
Austria	30.89	6
Czech Republic	29.42	7
Germany	29.07	8
Denmark	26.76	9
Netherlands	25.75	10
Poland	25.35	11
Latvia	24.07	12
Slovenia	20.42	13
Lithuania	19.80	14
France	19.29	15
United Kingdom	18.19	16
Slovakia	17.39	17
Romania	17.10	18
Belgium	13.52	19
Cyprus	12.32	20
Portugal	10.86	21
Bulgaria	10.09	22

Ireland	10.08	23
Hungary	7.28	24
Croatia	6.15	25
Italy	4.44	26
Spain	3.98	27
Greece	1.01	28

Once again, a correlation coefficient of each indicator was examined with the I^2-distance, the results of which are presented in Table 4.

Table 4. The correlation between I^2-distance and final indicators

Indicator	***r***
Employment rate	0.754**
Severely materially deprived people	0.737**
People living in households with very low work intensity	0.650**
Primary energy consumption	0.617**
People at risk of poverty or social exclusion	0.576**
Gross domestic expenditure on R&D	0.501**
Final energy consumption	0.488**
Share of renewable energy in gross final energy consumption	0.463*

As it could be seen, all observed indicators from the last calculation are statistically significant, meaning that this is the final calculation of the last two tables presenting the results in examining development of the countries observed. The most important indicator is Employment rate (r=0.754, p<0.01). The employment rate varies very significantly across countries and regions – the percentage of employed people aged 20-64 is reaching 68.95% on average in the EU in 2014. Sweden have the biggest employment rate of 80.00% while on the other side percent of employed people in Greece is 53.30%. The increasing share of young people neither in employment nor in education or training is another major source of concern. Next two indicators are from poverty and social exclusion group of indicators: percent of severely materially deprived people (r=0.737, p<0.01) and percent of people living in households with very low work intensity (r=0.650, p<0.01), which proves the assertion that fight against poverty is fundamental in reaching Europe 2020 Strategy goals (Jessoula, 2015; Copeland and Daly, 2014).

In Table 4 the final results of the I^2-distance Method, I^2-distance Value, and Rank are presented. The highest values of I^2-distance belong to Sweden, which tops the list, confirming previous research (Hudrlikova, 2013). It is interesting that Sweden has already reached RES (renewable energy sources) target. Estonia, which is ranked right below Sweden, has reached its overall objectives for RES-Electricity in 2013 (Cross et al., 2015).

In contrast to Sweden and Estonia, ranking at the bottom of this list are countries with the lowest development level – Greece, Spain and Italy. Previous researchers showed that in these countries the progress has not been observed or has been negligible (Klonowska-Matynia et al., 2015). Bearing in mind the values of selected indicators (especially for Greece), these results are to be expected. Investment in education has to be strengthened in particular within these Mediterranean countries, in terms of both quantity and quality (Gros and Roth, 2012).

4. CONCLUSION

The reasons for having a Europe 2020 Strategy are equally pressing in 2016 as they were in 2010. Emerging from the worst economic and financial crisis in a generation, the EU needs to strengthen its smart, sustainable and inclusive growth strategy so that it can deliver on the expectations of its citizens and maintain its role in the world. At the moment, the European Union is on its way to fulfill the objectives in the fields of education, climate and energy policy, but not in the area of employment, research and development, and poverty reduction. Furthermore, relative poverty rates are difficult to predict when employment increases and the impact is not necessarily a beneficial one (Marx et al., 2012).

In this paper, the I-distance method has been applied in order to measure the development level of EU countries, as based on Europe 2020 Strategy indicators. The research itself started with initial indicators and

several calculations led to the final set of indicators. The progress in achieving the objectives can be monitored using the described I-distance methodology, both for the EU as a whole and for each Member State individually. With this approach, not only can countries be ranked, but the differences between them can be better explored as well. In addition, the approach utilized in this paper can identify importance of each Europe 2020 Strategy indicator.

REFERENCES

Balcerzak, A.P. (2015). Europe 2020 Strategy and structural diversity between old and new member states. Application of zero unitarization method for dynamic analysis in the years 2004-2013. *Economics & Sociology,* 8(2), 190-210.

Bere, R.C., Precup, I.B. & Silvestru, C.I. (2015). On Growth Poles from EU Countries in The Framework of Europe 2020. *Procedia Economics and Finance*, 23, 920-925.

Copeland, P. & Daly, M. (2014). Poverty and social policy in Europe 2020: ungovernable and ungoverned. *Policy and Polytics,* 42(3), 351-365.

Cross, S., Hast, A., Kuhi-Thalfeldt, R., Syri, S., Streimkiene, D., & Denina, A. (2015). Progress in renewable electricity in Northern Europe towards EU 2020 targets. *Renewable & Sustainable Energy Reviews,* 52, 1768-1780.

Dobrota, M., Jeremic, V., & Markovic, A. (2012). A new perspective on the ICT Development Index. *Information Development,* 28(4), 271-280.

European Commission. (2010). Europe 2020: A Strategy for Smart, Sustainable and Inclusive Growth: Communication from the Commission. Publications Office.

Gros, D., & Roth, F. (2012). The Europe 2020 strategy: Can it maintain the EU's competitiveness in the world? Centre for European Policy Studies (CEPS), Brussels.

Hoedl, E. (2011). Europe 2020 Strategy and European Recovery. *Problemy Ekorozwoju,* 6(2), 11-18.

Hudrlikova, L. (2013). Composite indicators as a useful tool for international comparison: the Europe 2020 example. *Prague Economic Papers*, 22(4), 459-473.

Ivanovic, B., (1973). A method of establishing a list of development indicators. Paris, United Nations Educational, Scientific and Cultural Organization.

Ivanovic, B., & Fanchette, S., (1973). Grouping and ranking of 30 countries of Sub-Saharan Africa, two distancebased methods compared. Paris, United Nations Educational, Scientific and Cultural Organization.

Ivanovic, B., (1977). *Classification Theory*. Belgrade, Institute for Industrial Economic.

Jakab, Z., & Alderslade, R. (2015). Health 2020–Achieving Health and Development in Today's Europe. *Global Policy*, *6*(2), 166-171.

Jeremic, V., Bulajic, M., & Martic, M., (2011). A fresh approach to evaluating the academic ranking of world universities. *Scientometrics* 87(3), 587-596.

Jeremic, V., Bulajic, M., Martic, M., Markovic, A., Savic, G., Jeremic, D., & Radojicic, Z. (2012). An Evaluation of European Countries Health Systems through Distance Based Analysis. *Hippokratia,* 16(2), 170-174.

Jesoulla, M. (2015). Europe 2020 and the Fight against Poverty - Beyond Competence Clash, Towards "Hybrid' Governance Solutions? *Social Policy & Administration,* 49(4), 490-511.

Jovanovic, M., Jeremic, V., Savic, G., Bulajic, M., & Martic, M. (2012). How does the normalization of data affects the ARWU ranking? *Scientometrics,* 93(2), 319-327.

Klonowska-Matynia, M. & Sasin, M. (2015). EU Countries Socio-Economic Development in the Context of Europe 2020 Strategy. *Rocznik Ochrona Srodowiska,* 17(1), 771-791.

Marx, I., Vandenbroucke, P. & Verbist, G. (2012). Can higher employment levels bring down relative income poverty in the EU? Regression-based simulations of the Europe 2020 target. *Journal of European Social Policy,* 22(5), 472-486.

Milenkovic, N., Vukmirovic, J., Bulajic, M. & Radojicic, Z. (2014). A multivariate approach in measuring socio-economic development of MENA countries. *Economic Modelling,* 38, 604-608.

Radojicic, Z., Isljamovic, S., Petrovic, N., & Jeremic, V. (2012). A novel approach to evaluating sustainable development. *Problemy Ekorozwoju,* 7(1), 81-85.

Seke, K., Petrovic, N., Jeremic, V., Vukmirovic, J., Kilibarda, B., & Martic, M. (2013). Sustainable development and public health: rating European countries, BMC Public Health, 13, 1-7.

Terem, P., Cajka, P., & Rysova, L. (2015). Europe 2020 Strategy: Evaluation, implementation, and prognoses for the Slovak Republic. *Economics & Sociology,* 8(2), 154-171.

Vuković, M. (2011). Europe 2020 Strategy – priorities and goals. Faculty of Political Sciences, University of Belgrade,.Yearbook 5, 493-513.

A FUZZY LOGIC-BASED SYSTEM FOR ENHANCING SCRUM METHODOLOGY

Mihailo Stupar*[1], Pavle Milošević[1], Bratislav Petrović[1]
[1]University of Belgrade, Faculty of Organizational Sciences
*Corresponding author, e-mail: stupar.mih@gmail.com

Abstract: *In this paper, we propose a decision support system for enhancing scrum methodology based on fuzzy logic. The proposed system consists of three main components: a fuzzy inference system, an aggregation operator and a feedback function. In the basic scrum, requirements which describe a certain task do not have a clear interpretation. Also, the basic model does not take into account the experience of the developers as well as the logical dependencies of input variables. Fuzzy inference systems are particularly useful for this purpose, because it incorporates logic in inference process and inputs are presented using linguistic quantifiers. Aggregation function is used to aggregate predictions in a single value that uniquely represent a specific task while a feedback is employed to adjust an input variable to improve system performance. Further, the proposed system is simulated with randomly generated inputs in order to analyze it behavior. The predictions of the system are more accurate and with less deviation in the final iterations.*

Keywords*: scrum methodology, decision support system, fuzzy logic, fuzzy inference system, aggregation operator, feedback function*

1. INTRODUCTION

Scrum as an agile methodology is very popular within the software and product developers. Scrum is ideal for project with aggressive deadlines, complex requirements, and significant degree of uniqueness (Almseidin et al. 2015). Today, development teams are often distributed all over the world, but people still use this methodology for leading the project (Sutherland et al. 2007). In the scrum, projects move forward through the series of iterations called sprints, and each sprint is typically two to four weeks long.

At the start of each sprint, a whole team of developers has a meeting (sprint planning meeting) where they decide which tasks should be included in the following sprint. They all have a list of features/tasks (made by experts) that should be implemented by the end of the project. These features/requirements are collected in the Product Backlog (Duechting et al. 2007). Each task is weighted with some number of points. In the scrum, these points are called story points. The number of story points that come into the sprint is well known, but the number of tasks entered in the sprint depends on the developers' estimation how difficult each task is. In the sprint planning meeting, they argue about these costs of the tasks, and how many tasks from the Product Backlog will be included. They all give a value (weight) to each task independently. Later, their manager (scrum master) looking at the values for the task decides (with agreement with the team) how many story points this task actually costs.

Although the scrum methodology is successfully applied in various fields, there are certain issues that should be addressed to story point estimation. Developers often think that number of story points for each task means the number of hours/days to complete this task. The first assumption with the idea bout story points is that they are just points, relative values instead of absolute values. When someone looks into the values, he could be able to compare tasks based on story points and he should not be able to say how many hours/days are needed to complete them. Another issue is related to the experience of developers. Some developers are experienced and tasks are often too easy for them. On the other hand, some of them are bad in estimation. For example, they often give smaller value that it actually is.

Scrum master needs to think about all these parameters when decides what is the final value of story points for each task. Because fuzzy logic provides a useful tool to deal with problems in which the phenomena are imprecise and vague (Lin et al. 2006), it is ideal for our purpose. Our proposed system based on fuzzy logic could enhance efficiency in scrum planning phase. The system accepts developer's task estimation and scrum master's knowledge as inputs, and the output is weight (story point value) of the observed task. Also, the system should become more and more stable over time, and get more precise prediction.

This paper is structured as follows. In Section 2 we describe fuzzy logic and FIS in general, and how is it used previously in scrum methodology. In Section 3 we introduce our fuzzy logic-based system, an aggregation operator and a feedback function that should improve accuracy of the system. Further, we

create a simulation that shows how our system works, and this is explained in Section 4. Finally, Section 5 contains conclusion and ideas for further work.

2. FUZZY LOGIC

Fuzzy logic is a generalization of classical logic in a sense that it can process all values from the interval [0,1] (Zadeh, 1965, Zadeh, 2008). It may be seen as an attempt to formalize human capability to reason and make rational decisions in an environment of imprecision and uncertainty. In fuzzy logic, operators of intersection and union are realized using different functions that are referred to as t-norms and t-conorms (or s-norms), respectively. Min operator is the standard choice for fuzzy intersection, while algebraic product and Lukasiewicznorm are also frequently used (Ross, 2010). Max operator, probabilistic sum and Lukasiewicz t-conorm are it's corresponding as t-conorms. The most common negation operator in fuzzy logic is a standard negation $\bar{x} = 1 - x$.

2.1. Fuzzy inference system

A fuzzy inference system (FIS) is a system based on fuzzy logic that utilizes a set of rules to map inputs to outputs. It is the most commonly seen fuzzy methodology. Two most important types of the FIS are Mamdani (Mamdani, 1977) and Takagi–Sugeno (Takagi and Sugeno, 1985). In the Mamdani system, both input and output are fuzzy sets and it is easier to interpret. In the Takagi–Sugeno system inputs are fuzzy sets, while the output is a linear combination of its inputs. This type of FIS is more accurately one, but more computationally expensive. The fuzzy inference systems are particularly useful in problems where inputs are expressed as linguistic expressions. The FIS is based on IF-THEN rules, fuzzy conditional statements that incorporate logic. They are a collection of linguistic statements that describe how the FIS should make a decision. Just like an algebraic variable takes numbers as values, a linguistic variable takes words or sentences as values. Their IF part is a logical condition that should be fulfilled in order to THEN part be realized. IF-THEN rules are commonly specified by a field expert.

The fuzzy inference process consists of three main steps: fuzzification, rule evaluation and defuzzification. The first step in fuzzy inference is to convert linguistic expressions to values on the unit interval [0,1] using a set of input membership functions. Further, fuzzy rules are evaluated using appropriate operators for t-norm, t-conorm and negation. Results of all IF-THAN rules are aggregated into a single fuzzy set. Finally, defuzzification is applied. It is a process that converts a fuzzy set or a fuzzy number into a crisp value, representing the final output.

2.2. Fuzzy logic in the scrum methodology

Fuzzy logic proved to be particularly useful for building expert system based on logical dependent variables. It is especially suitable when inputs are expressed as linguistic statements. Due its characteristics fuzzy logic is widely used as a tool for enhancing scrum methodology.

In (Sedehi and Martano, 2012) they introduced a new model based on fuzzy logic that is used to evaluate and monitor scrum projects. Their model has linguistic variables as inputs and output is the level of success of the (part of) scrum project. In (Kurian, 2011) is created Sugeno based fuzzy model that should determine and react to changes in an agile process, such as product/software development process. Similar approach stands in (Lin et al. 2006), where they used Mamdani based model to register changes in the enterprise world.

3. DESIGN OF FUZZY EXPERT SYSTEM

The goal of this paper is to build fuzzy expert system that can be a valuable support or even replace an expert (scrum master) during the each sprint planning phase. Rules that scrum master follow in the decision making process can be easily expressed linguistically, so the fuzzy logic system is suitable for this kind of problem (Lin et al. 2006). Proposed system consists of three components: fuzzy inference system (FIS), aggregation function and feedback function. Experts' knowledge should be used only in the first iteration in order to set up initial parameters.

3.1. Fuzzy inference system

Our fuzzy logic system has three input variables that describe the experience of developers, their estimation skills and their rating for observed task. The output is a value (story point value) of the observed task.

In case of the experience (EXP) input variable, every developer has a specific status in the company, which is based on years of experience. Instead of using four groups (junior, intermediate, senior, and expert) which is common in literature (Orlowsky et al. 2006), we decide to exclude expert group from our system. Experts are more often leaders and they define tasks that should be done instead of task implementation. So, our EXP variable consists of three membership functions, each one is for one level of experience. Every membership function in this paper is a PI - shaped function defined by four parameters. These parameters are specified by an expert using the fuzzy visualization tool in MATLAB (Sivanandam et al. 2007). In the Table 1 parameters for every membership function for EXP variable are shown. Values represent the years of experience and they are comma separated.

Table 1: Membership function parameters for EXP variable

Variable	Values of parameters
Junior	0, 0, 1.183, 2.64
Intermediate	1.52, 2.69, 3.706, 5.04
Senior	3.579, 5.18, 6.24, 8.16

Second input variable describes an accuracy/quality of developer's estimation how much the specific task is complex (EST). This variable may be of great importance for the inference process since some developers constantly miscalculate the task complexity. It is linguistic in nature and it is represented with three membership functions: Overestimated, Well Estimated, and Underestimated, while the assessments are on the interval $[1,7]$. Membership functions' parameters are shown in Table 2.

Table 2: Membership function parameters for EST variable

Variable	Values of parameters
Overestimated	-1.62, 0.779, 1.85, 3.452
Well Estimated	2.071, 3.26, 4.61, 5.99
Underestimated	4.516, 6.29, 7.3, 9.7

Bearing in mind that the accuracy of each developer's estimations may vary over time, EST values will be adjusted after each iteration. The proposed system has a sort of feedback at the end of the each iteration that should improve the validity of EST variable. Detailed explanation of feedback will be given later in the text.

Finally, the third input variable is a weight/rating that the developer gives to each task (WEI). Although human expression can be interpreted with 9 linguistic terms (Lin et al. 2006), in agreement with scrum master we decide to represent this variable with three values (easy, medium, heavy), while the expert's assessments are on the interval $[1,7]$. This task weight representation is intuitive, close to human perception and based on natural language. All these variables are PI-shaped as well, and their parameters are represented in the Table 3.

Table 3: Membership function parameters for WEI variable

Variable	Values of parameters
Easy	-1.16, 0.76, 1.75, 3.53
Medium	1.94, 3.34, 4.5, 5.93
Heavy	4.67, 6.12, 7.24, 9.16

The output of the fuzzy system is a numeric value that represents the weight of the task in story point context, and all values are split into four groups: Easy, Medium, Complex, and Very Complex. Although the valid story point values in basic scrum methodology belong to modified Fibonacci array (1/2, 1, 2, 3, 5, 8…) (Downey and Sutherland, 2013), we decided to represent output using a uniform distribution. If we use Fibonacci array, we would have a very small difference between easy and medium group and a very big gap between complex and very complex groups (see Table 4). As a result, the tasks would be weighted as a Complex or Very Complex with high probability.

Table 4: Story point distribution using Fibonacci array

Group name	Values
Easy	1/2, 1, 2
Medium	3, 5, 8
Complex	13, 21, 34
Very Complex	55, 89

It's obvious that this distribution cannot give good results because fuzzy system threats all membership functions equally and Very Complex membership function takes almost half of the full output interval. Instead of using these values, the parameters of output membership functions are rescaled (Table 5).

Table 5: Output membership functions' parameters

Group name	Values of parameters
Easy	0, 0, 2.69, 15.56
Medium	3.53, 10.92, 16.07, 25.34
Complex	16.8, 23.96, 30.02, 38.78
Very Complex	27.95, 39.98, 50, 55

Using these inputs and output we created set of rules for our fuzzy system. We follow scrum master thoughts and recommendations during the scrum planning phase. This phase is interactive and he/she leads it with his/her suggestions. These advices are transformed into the following set of rules:

1. IF (EST = WELL_EST) and (EXP is not JUNIOR) and (WEI is EASY) THEN (OUT is EASY)
2. IF (EST = OVER_EST) and (WEI is not EASY) THEN (OUT is EASY)
3. IF (EST = UNDER_EST) and (EXP is not SENIOR) and (WEI is EASY) THEN (OUT is MEDIUM)
4. IF (EST = OVER_EST) and (WEI is not EASY) THEN (OUT is MEDIUM)
5. IF (EST = OVER_EST) and (EXP is not SENIOR) and (WEI is HEAVY) THEN (OUT is COMPLEX)
6. IF (EST = UNDER_EST) and (EXP is not JUNIOR) and (WEI is HEAVY) THEN (OUT is COMPLEX)
7. IF (EST = WELL_EST) and (EXP is not JUNIOR) and (WEI is HEAVY) THEN (OUT is V_COMPLEX)
8. IF (EST = UNDER_EST) and (WEI is not EASY) THEN (OUT is V_COMPLEX)

The proposed FIS is Mamdani-type. This type of FIS ensures the necessary transparency of the decision making process. AND operator is evaluated using *min* function, OR operator with *max* function and in the defuzzification process we use centroid method.

In the Figure 1 is shown how OUT values change for different EXP and EST values and constant WEI value. If a developer is a good estimator (EST value is close to 4), the OUT value is high (since WEI is high) except in the case of inexperienced developers (EXP < 2). Since inexperienced developers do not have enough knowledge yet, they may perceive medium tasks as difficult once. On the other hand, developers who usually overestimate their tasks have OUT values smaller than predicted (about 2).

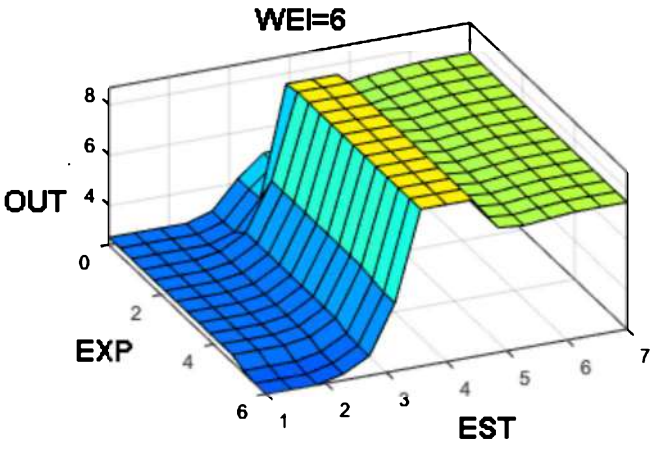


Figure 1: Output values for WEI=6

3.2. Aggregation function

Each developer has its own input vector and the fuzzy system gives a separate output for each task. In other words, for each task we get as many outputs as there are developers in our system. In second layer we aim to aggregate these predictions in a single value that uniquely represent specific task. Since characteristics of each developer are taken into account in FIS, all FIS output values should be treated equally. Therefore, we propose a simple average as the aggregation function.

Scrum master insights regarding certain team and/or project may be expressed by using various aggregation functions in this layer. For example, if the optimistic estimation is needed, the proper aggregation function is *max* function. For calculating pessimistic estimation *min* function should be used.

3.3. Feedback

The third and very important layer is feedback function which is represented in the Figure 2. At the end of each iteration/sprint we can see how difficult each task was, and this variable is represented with REAL_OUT value. Using this REAL_OUT and ESTIMATED_OUT values for the i^{th} spring we can update EST value for each developer in the $(i+1)^{th}$ sprint. For example, let assume that developer D is a good estimator and that he states that some task T is a heavy one (WEI). After the sprint if it is turned out that the task T is easy in general (REAL_OUT), developer D should not be concerned as a good estimator in the next iteration (EST).

The feedback is realized as the quadratic function of the difference between real and estimated difficulty. The function is weighted in order to get a weaker slope of the function. Using this function, we will award or penalize developer EST value if he has had a god or bad estimation.

Using this set of rules and feedback function, the system should improve itself over time and become stable after few sprints. Furthermore, we can assess developer's estimations in order to analyze their tendency to overestimate or underestimate the task over a period of time. At the beginning, we can assume that all developers are good estimators, and by the end of the project we will see how good they actually are. These (trained) values should be starting points in the next project so we could expect better results from the start.

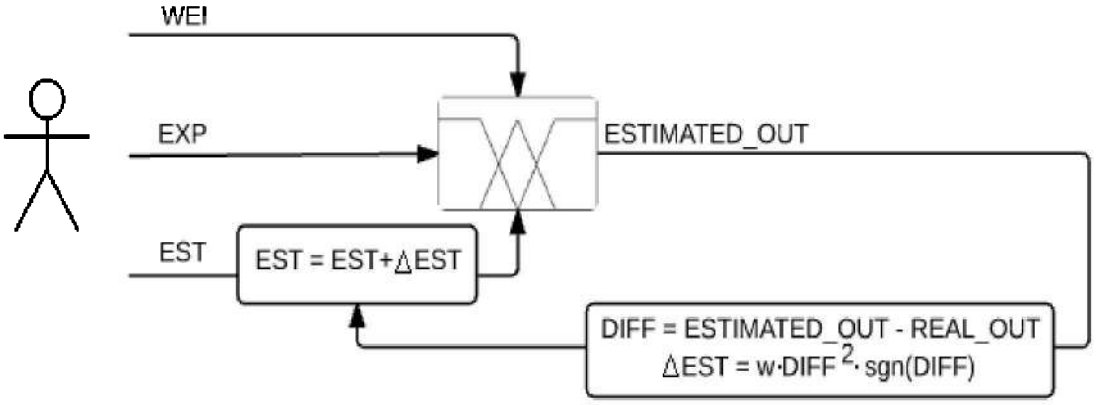


Figure 2: Design of the fuzzy expert system

4. EXPERIMENT

In this section we present the simulation in order to illustrate how the proposed system works. We will simulate the work on the project that consists of two sprints with six tasks. Five experts with various levels of experience participate in the project.

First, the initial values of the estimation accuracy EST and experience EXP variables for each developer are assigned. Further, we assign output values REAL_OUT for each task in one sprint. REAL_OUT represents the actual complexity of the task, that includes both objective circumstance and human factor. On the otherhand, it will be also used as a base for WEI value calculation in this simulation.

We are going to use these output values in order to find out the mean squared error of each task in the estimation process. EST, EXP and REAL_OUT values are taken from a uniform distribution. Finally, the weight/rating that the developer gives to each task WEI is calculated based on EST and OUT values.

WEI value calculation. Values of variable WEI cannot be randomly generated because it depends on characteristic of the tasks (summarized in REAL_OUT) and correctness of developer's estimations (explained with EST). Though, we calculate WEI in such a way that resembles a developer's evaluation.

$$OFFSET = EST - CENTER_EST \tag{1}$$

$$WEI = OFFSET \cdot c - REAL_OUT, \quad c = 0.35 \tag{2}$$

First, in (1) we calculate offset or distance from the center of all EST values. EST values are uniformly disturbed on the interval $[1,7]$, so in our case CENTER_EST is 4. Further, WEI value is calculated using the formula (2). The value of coefficient *c* is obtained through testing and set to 0.35.

FIS evaluation. Next, we use EST, EXP and WEI as inputs for our fuzzy inference system in order to get ESTIMATED_OUT as output. We are going to get as many ESTIMATED_OUT values for a single task as we have developers on the project. Note that in the first iteration we use INIT_EST value for EST variable. In further iterations, EST values are going to be calculated with feedback function.

EST value improvement using feedback. After each iteration EST value is updated in accordance with prediction accuracy. Thus, the adaptability of the system and its robustness to changes are assured.

$$\Delta OUT = ESTIMATED_OUT - REAL_OUT \tag{3}$$

$$\Delta EST = \Delta OUT^2 \cdot w \cdot \operatorname{sgn}(\Delta OUT), \quad w = 0.05 \tag{4}$$

$$EST_i = EST_{i-1} + \Delta EST \tag{5}$$

In the equation (3), we calculate the difference between predicted and real output weights. Later, we use weighted quadratic function (4) to calculate the value which will be added to the EST value from the previous iteration (5). The value of weighting coefficient *w* is set to 0.05.

The evaluation of the system. Instead of evaluating our system as a set of iterations (Sedehi and Martano, 2012), we will utilize the difference between the aggregated estimated and actual output (ΔFIN_OUT) and mean squared error (MSE) for each task as performance measures. We use ESTIMATED_OUT values from each developer and aggregate them using the average function into ESTIMATED_OUT_AVG. This value will be compared to the REAL_OUT value to obtain the difference between the estimated and actual output. MSE is used as a deviation indicator of individual prediction ESTIMATED_OUT. Firstly, we calculate mean squared error for each developer separately and then apply average function on them to get a single MSE. This value could show how stable our system is.

Table 6: MSE for Sprint 1

TASK	ESTIMATED_OUT_AVG	REAL_OUT	ΔFIN_OUT	MSE
1	3.8620	4	0.138	3.8765
2	5.1015	5	0.1015	8.8885
3	0.8593	2	1.1407	1.3015
4	1.1220	3	1.878	3.5324
5	0.8551	2	1.1449	1.3111
6	1.1198	3	1.8802	3.5687
AVERAGE			**1.0472**	**3.7465**

Table 7: MSE for Sprint 2

TASK	ESTIMATED_OUT_AVG	REAL_OUT	ΔFIN_OUT	MSE
1	3.9489	4	0.0511	1.6600
2	1.2121	3	1.7879	3.2835
3	0.8594	2	1.1406	1.3013
4	1.8630	2	0.137	0.2163
5	4.3738	4	0.3738	3.2725
6	1.1049	1	0.1049	0.1093
AVERAGE			**0.5992**	**1.6405**

In Tables 6 and 7 results for two sprints are presented together with ΔFIN_OUT and MSE. In general, the average accuracy of prediction in Sprint 2 is increased compared to Sprint 1 while the MSE value is decreased. Based on MSE values we can see that our system becomes more and more stable over time. At the beginning, even in cases when it produces a good prediction of the task complexity, i.e. for task 2 in Sprint 1, it has high deviation of individual assessments. For Sprint 2, MSE values are significantly lower. Therefore, we can state that besides greater estimation accuracy, the proposed fuzzy logic-base system improves the stability of individual assessments.

5. CONCLUSION AND FUTURE WORK

Fuzzy logic has been widely used to assist decision makers in a number of different domains. In this paper, it is utilized as a basis for building a decision support system to determine the weight of the tasks in agile methodology such as scrum. The system consists of three modules: a fuzzy inference system, an aggregation operator and a feedback function.

We consider that there is no need to use unique predefined values for estimation in the scrum (as Fibonacci series), but we can efficiently use linguistic variables to get the same goal. Using the proposed fuzzy inference systems we enhance each developer's story point estimation in accordance with their experience and previous prediction accuracy. The knowledge of scrum master is transformed is fuzzy rules that are easy to interpret and fully resemble human reasoning. The output variables are further aggregated in a final estimation using a simple average. Feedback is applied to update the variable that represents each developer's quality estimation in order to increase adaptability to changes and poor assessments. We have simulated the proposed system and shown that it becomes more stable over time and gives more accurate predictions of the tasks.

The proposed system could be more accurate if we take into account additional input variable in the FIS that represents how often requirement are going to change in the sprint. Some tasks/requirements are not fixed during the whole sprint and this may lead to breaking a deadline. The idea for future work is to incorporate that variable in proposed system and to add more rules that will treat these tasks differently from stable ones. Also, we aim to use various aggregation operators is ordered to model different problem situations.

REFERENCES

Almseidin, M., Alrfou, K., Alnidami N., & Tarawneh A. (2015). A Comparative Study of Agile Methods: XP versus SCRUM. *International Journal of Computer Science and Software Engineering,* 4(5), 126-129.

Downey, S., & Sutherland, J. (2013). Scrum metrics for hyperproductive teams: how they fly like fighter aircraft. In *System Sciences (HICSS), 2013 46th Hawaii International Conference on*, 4870-4878. IEEE.

Düchting, M., Zimmermann, D., & Nebe, K. (2007). Incorporating user centered requirement engineering into agile software development. In *Human-computer interaction. Interaction design and usability*, 58-67. Berlin: Springer.

Kurian, T. (2011). A Fuzzy Based Approach for Estimating Agility of an Embedded Software Process. Retrieved from http://www.siliconindia.com/events/siliconindia_events/Global_Embedded_conf/Globa_Embedded_Conf_PPT_final_tisni.pdf

Lin, C. T., Chiu, H., & Tseng, Y. H. (2006). Agility evaluation using fuzzy logic. *International Journal of Production Economics*, 101(2), 353-368.

Mamdani, E. H. (1977). Application of fuzzy logic to approximate reasoning using linguistic synthesis. *IEEE Transactions on Computers*, 100(12), 1182-1191.

Orłowski, C., Bach-Dąbrowska, I., Kapłański, P., & Wysocki, W. (2014). Hybrid Fuzzy-ontological Project Framework of a Team Work Simulation System. *Procedia Computer Science*, 35, 1175-1184.

Ross, T. J. (2010). *Fuzzy logic with engineering applications (*3rd ed.). Chichester: John Wiley & Sons.

Sedehi, H., & Martano, G. (2012). Metrics to Evaluate & Monitor Agile Based Software Development Projects-A Fuzzy Logic Approach. In *Software Measurement and the 2012 Seventh International Conference on Software Process and Product Measurement (IWSM-MENSURA), 2012 Joint Conference of the 22nd International Workshop on,* 99-105. IEEE.

Sivanandam, S. N., Sumathi, S., & Deepa, S. N. (2007). *Introduction to fuzzy logic using MATLAB* (Vol. 1). Berlin: Springer.

Sutherland, J., Viktorov, A., Blount, J., & Puntikov, N. (2007). Distributed scrum: Agile project management with outsourced development teams. In *System Sciences, 2007. HICSS 2007. 40th Annual Hawaii International Conference on*, 274a-274a. IEEE.

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

Zadeh, L. A. (2008). Is there a need for fuzzy logic?. *Information sciences*, 178(13), 2751-2779.

APPLYING THE ANALYTIC HIERARCHY PROCESS TO RANK CITY-BRANCHES

Violeta Cvetkoska*[1], Nina Begicevic Redzep[2]
[1]Ss. Cyril and Methodius University in Skopje, Faculty of Economics – Skopje, Skopje, Republic of Macedonia
[2]University of Zagreb, Faculty of Organization and Informatics, Varazdin, Croatia
*Corresponding author, e-mail: vcvetkoska@eccf.ukim.edu.mk

Abstract: *The aim of the paper is to present developed AHP model for ranking city-branches of a bank. According to the number of active counters the city-branches of the bank are classified into the following three groups: group A with 1-3 active counters, group B with 2-5 active counters and group C with 4-9 active counters. The developed AHP model consists of a goal, criteria and alternatives. The goal is to rank the city-branches in the groups they belong to. The 8 criteria that are defined in the model are: denar savings, foreign currency savings, transaction accounts, exchange operations, public services, master cards, fees for payment operations (commission), and domestic payment operations. The alternatives are the city-branches that belong to each group. Developed AHP model is validated for ranking the city-branches of Commercial bank AD Skopje which are located in Skopje. The programming tool Super Decisions is used to implement the AHP model and the programming tool Expert Choice is used to perform sensitivity analysis. The obtained results are presented and analyzed in the paper.*

Key words*: multi-criteria decision-making, Analytic Hierarchy Process, ranking, sensitivity analysis, bank, city-branches*

1. INTRODUCTION

One of the key sectors that enable the economy to function is the banking sector. Banks play a vital role in the world's economy. They are authorized financial institutions that collect deposits and provide loans to individuals and legal entities, and they are largely responsible for the payment system. At the community level they do their activities through branches and city-branches.

This paper presents the applicability of the multi-criteria decision making method – the Analytic Hierarchy Process (AHP) to rank city-branches of a bank. The Analytic Hierarchy Process was developed by Thomas L. Saaty in the late seventies of the previous century (Saaty, 1977, 1980). It is designed to solve multi-criteria decision problems which can be decomposed into the following elements: goal, criteria, sub-criteria and alternatives. These elements are then structured in a hierarchy. The decision-maker makes a pair comparisons of the elements of each level of the hierarchy and provides judgments about the relative importance of each criterion regarding the goal, afterwards specifying a preference for each alternative regarding each of the criteria. The outputs of AHP are the weights of the criteria and the priorities of the alternatives. This method enables the quantitative and qualitative factors to be considered and it supports individual and group decision-making.

The AHP model for ranking the city-branches has been developed and validated on the case of one of the largest and most renowned banks in the Republic of Macedonia – Komercijalna Banka AD Skopje. The sample consists of the city-branches that are located in Skopje, while the analysis was made for 2011. In order to implement the AHP model and examine whether the ranking of the city-branches is stable, programming tools Expert Choice and Super Decisions were used.

Aside from the introduction, state of the art is given in Section 2. The objectives of the research and the research methodology are stated in Section 3. The Analytic Hierarchy Process is described in Section 4. The developed AHP model is explained in Section 5, while the validation of the model is given in Section 6. The sensitivity analysis is performed in Section 7, and the conclusion is given in Section 8.

2. STATE OF THE ART

Multi-criteria decision-making (MCDM) is a sub-field of Operational Research/Management Science, which refers to making decisions in the presence of a number of criteria that in most cases are conflicting. From the 1960-ies onwards it is considered to be an active research area and it has produced a high number of articles and books (Roy, 2005).

Velasquez & Hester (2013) give a literature review of common MCDM methods, pointing out the advantages and disadvantages of each method and their areas of application. They considered the following methods of MCDM: multi-attribute utility theory (MAUT) (see Fishburn, 1967; Keeney, 1974, 1977), Analytic Hierarchy Process (see Saaty, 1977, 1980), fuzzy set theory (see Zadeh, 1965), case-based reasoning (CBR) (see Aamodt & Plaza, 1994), data envelopment analysis (DEA) (see Charnes et al.,1978; Cooper et al., 2007; Thanasssoulis 2001), simple multi-attribute rating technique (SMART) (see Edwards, 1971, 1977), goal programming (GP) (see Charnes et al., 1955), ELimination and Choice Translating Reality (ELECTRE) (for ELECTRE I see Roy, 1968, for ELECTRE IS see Roy & Skalka (1984), for ELECTRE II see Roy & Bertier (1973) for ELECTRE III see Roy (1978), for ELECTRE IV see Roy & Hugonnard (1982) and for ELECTRE TRI see Roy & Bouyssou (1993)), Preference Ranking Organization METHod for Enrichment of Evaluations (PROMETHEE) (for PROMETHEE I and II see Brans et al. (1984)), simple additive weighting (SAW) (for SAW see Hwang & Yoon, 1981) and technique for order of preference by similarity to ideal solution (TOPSIS) (for TOPSIS see Hwang and Yoon, 1981, Yoon, 1987, Hwang et al., 1993).

Mardani et al. (2015) made a literature review for MCDM techniques and their application. They considered 393 articles, published in more than 120 international peer-reviewed journals from the Web of Science database in the period 2000-2014. The articles are grouped in the following 15 fields: energy, environment and sustainability, supply chain management, material, quality management, GIS, construction and project management, safety and risk management, manufacturing systems, technology management, operation research and soft computing, strategic management, knowledge management, production management, tourism management and other fields. The highest number of articles (109) is found in the application field of operation research and soft computing, followed by the field of energy, environment and sustainability with 53 articles, and only 5 articles are applied in the field of knowledge management. The European Journal of Operational Research has published the highest number of articles (70), followed by the Journal of Expert Systems with Applications, having published 20 articles. According to the frequency of application of decision-making techniques (AHP, ELECTRE, DEMATEL, PROMETHEE, TOPSIS, ANP, aggregation DM methods, hybrid MCDM and VIKOR), the most used one is the AHP (128 articles), followed by: the hybrid MCDM (64 articles), aggregation DM methods (46 articles), TOPSIS (45 articles), ELECTRE (34 articles), ANP (29 articles), PROMETHEE (26 articles), VIKOR (14 articles), and DEMATEL (7 articles).

When a choice of the best alternative from several alternatives has to be made, or alternatives should be ranked so that multiple criteria are taken into consideration on the basis of which alternatives are evaluated, the Analytic Hierarchy Process is one of the most commonly used MCDM methods. It can be used to solve complex problems in education, healthcare, banking, manufacturing, government, sport, etc. In the focus of this paper is the application of the AHP in banking, more specifically to rank city-branches of banks, so below we refer to the references in this field.

Javalgi et al. (1989) apply the AHP for bank management and their empirical analysis was conducted in a major metropolitan area. Arbel & Orgler (1990) apply the Analytic Hierarchy Process to bank strategic planning, i.e. bank mergers and acquisitions strategy. They developed a model that was tested in a bank holding company. Xie & Gong (2008) use fuzzy AHP and Balanced Scorecard to evaluate the performance of commercial banks. Haghighi et al. (2010) use fuzzy AHP in order to examine the impact of 3D-readiness on the development of e-banking in Iran. They have interviewed thirty bank managers and experts in Iran, and have concluded that the most important attribute of the development of e-banking is “industry e-readiness”. Onder et al. (2013) evaluate the financial performance of Turkish banks by using the methods: AHP and TOPSIS. The observed period in the study is 2002-2011. Rezaei et al. (2013) use fuzzy AHP to determine effective factors weight on optimizing the balance sheet of banks. The study is applied in the Refah bank. Nasrabadi et al. (2014) rank five branches of the Sina bank from the perspective of electronic banking by using the AHP. The following were included as criteria: efficiency and system responsiveness, quality and safety of provided data and services, customer and customer-orientation, designing and implementing e-services, and web 2.0 tools recruitment. The relative weight of the criterion efficiency and system response was the highest (0.345), followed by: quality and security of information and services (0.276), customer and customer-orientation (0.169), designing and implementing e-services (0.121), and using web 2.0 tools (0.890).

In the existing literature there was not found an article with an application of the AHP like this presented in our paper thus leading to the conclusion that this is an original application of the AHP.

3. OBJECTIVES AND RESEARCH METHODOLOGY

The objectives of the empirical research are:

- to develop AHP model for ranking the city-branches of banks;
- to validate developed AHP model by performing a ranking of the city-branches in the groups they belong to – case study of Commercial bank AD Skopje
- to perform sensitivity analysis in order to examine the sensitivity, i.e., the stability of the obtained results.

The main goal of this paper was to present developed AHP model for prioritization of city-branches of bank that is a model that can be used for comparisons of city-branches in general; to present results of the AHP model validation in comparisons of city-branches of Commercial bank AD Skopje.

In order to realize the objectives of the research, the followlwing steps were done:

- to conduct an interviews with the Manager of the Independent Domestic Payment Operations Department and with employees in this Department to define criteria for ranking the city-branches and to develop the AHP model;
- to collect judgements of respondents to assess the importance of the criteria in terms of the goal, and priorities of alternatives in terms of each criterion;
- to perform sensitivity analysis by using the programming tool Expert Choice.

In order to identify the criteria, the method of interview was used and for assessment of the importance of criteria and priorities of alternatives the results of the survey were used (it was designed a questionnaire which was distributed to respondents by e-mail).

4. THE ANALYTIC HIERARHY PROCESS (AHP)

The AHP method is one of the most widely exploited MCDM decision-making methods in cases when the decision, it means the selection of given alternatives and their prioritizing, is based on several tangible and intangible criteria (sub-criteria). The process of complex decision problem solving is based on the problem decomposition into a hierarchy structure which consists of the goal, the criteria, sub-criteria and the alternatives. Hence the AHP is a general theory of relative measurement. It is used to derive relative priorities on absolute scales from both discrete and continuous paired comparisons in multilevel hierarchic structures based on the judgment of knowledgeable and expert people (Saaty, 2001). On the basis of the pair-wise comparisons, relative significance (weights) of elements of the hierarchy structure is calculated. The AHP can combine these judgments into a single representative judgment for the group and also including the importance of the individuals themselves.

The AHP method application can be explained in four steps (Saaty & Begicevic, 2010, Begicevic et al., 2011):

1. The AHP enables decision makers to structure decisions hierarchically. The hierarchy model of the decision problem is developed in such a way that the overall goal of the decision is at the top of the model, strategic objectives in the higher levels, evaluation criteria in the middle levels, and alternative choices at the bottom.
2. After the hierarchy has been determined, the decision makers begin the procedure of prioritizing in order to determine the relative importance of elements on each level. The AHP provides a structured framework for setting priorities on each level of the hierarchy using pair-wise comparisons, a process of evaluating each pair of decision factors at a given level on the model for their relative importance with respect to their parent. On each hierarchy structure level, the pair-wise comparisons should be done by all possible pairs of the elements of this level, starting with the top of the hierarchy and working its way to the lowest level. The decision maker's preferences are expressed by numeric values on 1-3-5-7-9 scale - Intensity of Importance Scale (Table 1).
3. On the basis of the pair-wise comparisons, relative significance (weights) of elements of the hierarchy structure are calculated, which are eventually synthesized into an overall priority list of alternatives. Decision maker is allowed to change preferences and to test the results if the inconsistency level is very high. The consistency of the judgments is tracked using the rigorous math

analytics behind the AHP to validate the decision process. In cases where inconsistency is above 10% it is recommended that the criteria and judgments be revisited (Saaty, 1980).

4. Results are priorities of the alternatives and hierarchy tree with objective's relative significance. The sensitivity analysis is also carried out. Sensitivity analysis is used to determine the sensitivity of the alternatives to changes in the objectives' priorities.

Table 1: Intensity of Importance Scale (Saaty, 2012, p. 6)

Intensity of importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
2	Weak	
3	Moderate importance	Experience and judgment slightly favor one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgment strongly favor one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favored very strongly over another; its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation
Reciprocals of above	If activity *i* has one of the above nonzero numbers assign to it when compared with activity *j*, then *j* has the reciprocal value when compared with *i*	A reasonable assumption
Rationals	Ratios arising from the scale	If consistency were to be forced by obtaining *n* numerical values to span the matrix

5. DEVELOPING THE AHP MODEL FOR RANKING THE CITY-BRANCHES

The constructed AHP model consists of a goal, criteria, and alternatives. The goal is to rank the city-branches of the bank in the groups to which they belong, the alternatives are the city-branches that belong to each group, and in order to determine the criteria, the Manager of the Independent Domestic Payment Operations Department and the employees in this Department were chosen as respondents. The determination of the criteria was based on the results of interviews, questionnaires and qualitative analysis of relevant documents.

The activities which take place in the groups of city-branches are: denar savings, bank accounts, foreign currency savings, loans, transaction accounts, foreign exchange operations, other services, public services, master cards, business trip, commission, domestic payment operations, statements of transaction accounts, standing orders for utilities, issuing lists of codes, documents for bank cards, contracts for e-banking and input pensions. According to the value of each criterion for which data from internal reports of the bank departments are used, 8 activities are selected, which have the highest values in the observed period and the same serve as criteria: denar savings, foreign currency savings, transaction accounts, exchange operations, public services, master cards, fees for payment operations (commission), and domestic payment operations. The criteria are described in Table 2.

The AHP model for ranking the city-branches that belong to group A is presented in Figure 1, and in an analogous manner the AHP models for ranking the city-branches of groups B and C can be represented.

Table 2: Description of criteria

Criteria	Description
Denar savings	Deposit and money withdrawal from savings bank book, interest, authorization, representation, opening and replacement of savings book, etc.
Foreign currency savings	Deposit and money withdrawal from savings bank book, pledge of foreign currency deposit, conversion, interest, authorization, representation, opening and replacement of savings book, etc.
Transaction accounts	Cash and non-cash transfers, interests, statement of account, opening transaction account, authorization, representation, etc.
Exchange operations	Purchase/sale of foreign currency, difference in exchange rates-exchange operations, check received on encashment
Public services	Payments for public services, embassies, Western Union
Master Cards	Pay-in and pay-out (master card transfers)
Fees for payment operations (commission)	Fees (commission) calculated and charged while transaction being processed by bank clerk
Domestic Payment Operations	Cash and non-cash payments (payments-in and withdrawals) processed through payment instruments in the domestic payment operations

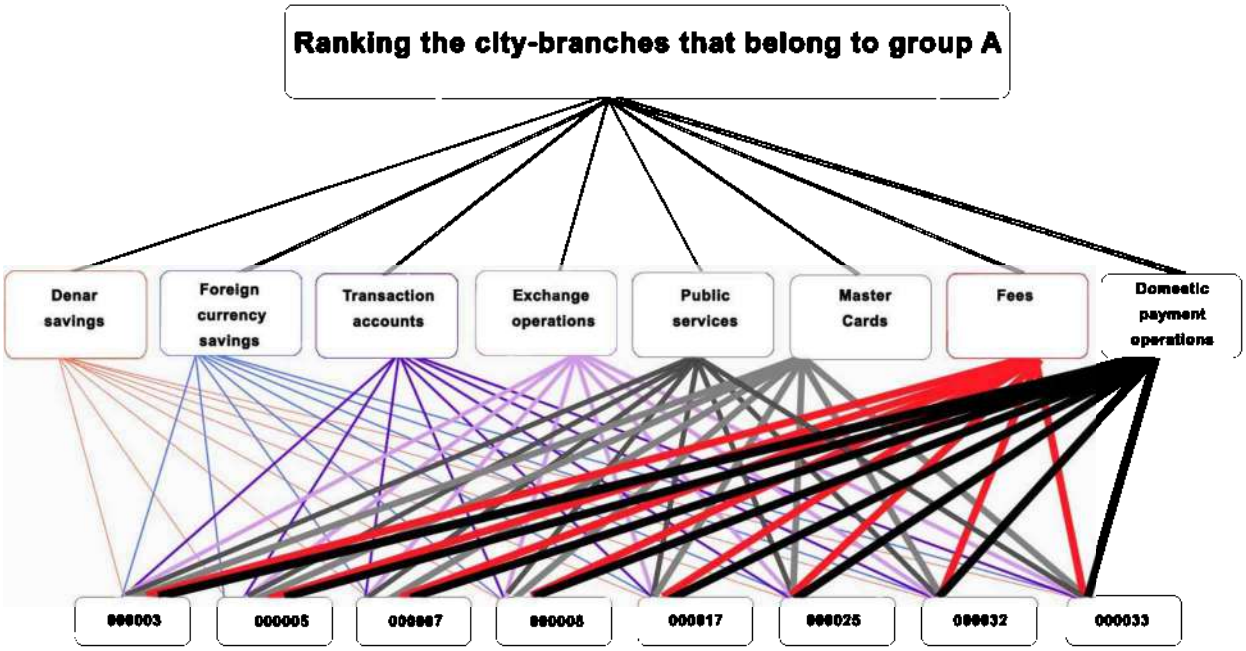


Figure 1: The AHP model for ranking the city-branches that belong to group A

6. VALIDATION OF THE AHP MODEL

The AHP is applied for ranking the city-branches of Commercial bank AD Skopje that are located in Skopje (11 Oktomvri, Avtokomanda, Biser, Buket, Bunjakovec, Butel, Vlae, Vodnjanska, GTC 1, Drachevo, Gjorce Petrov, Ekonomski fakultet, Jane Sandanski, JAT, Kapishtec, Kjubi, Leptokarija, Lisiche, Makpetrol, Madzari, MVR, Nova Makedonija, Novo Lisice, Partizanska, Rasadnik, Ruzveltova, Skopjanka, Stopanska komora na Makedonija, Sudska palata, Topansko pole, Cvetan Dimov, Centrala, Cair, Cento, Cesma, and Shuto Orizari).

Information about the profile of the bank's city-branches are obtained through the conducted interviews with the Chief Operative Officer of the bank and the Manager of the Independent Domestic Payment Operations Department.

According to the number of active counters, the city-branches are classified in the following three groups: group A with 1-3 active counters, group B with 2-5 active counters, and group C with 4-9 active counters. Groups A and B differ only in the number of employees, and group C, despite the number of employees, differs from groups A and B in that it has counters for transaction accounts and the following services can be performed: standing orders for utilities, issuing lists of codes, documents for bank cards, contracts for e-banking and input pensions.

In order to rank the city-branches of Commercial bank AD Skopje in the groups they belong to, the period from 2008 to 2011 was covered, and for an adequate comparative analysis, only the city-branches that belong to each of the groups in 2008 are taken into consideration for the entire observed period. Since the transactions which are done in the Head Office are significantly extensive, more complex and may not be comparable and placed in correlations made between the three groups of branches, they are excluded from the analysis. The research in the bank was conducted in 2011 and the data was collected in the period between 2008-2011 in which was obtained permission to use the data. The data used in the AHP model is not made public and is considered confidential, therefore it is not given in the paper, and the real name of the city-branches have been replaced with numbers. The following eight city-branches belong to group A: 000003, 000005, 000007, 000008, 000017, 000025, 000032 and 000033. Eleven city-branches belong to group B, and they are: 000006, 000009, 000012, 000016, 000020, 000027, 000028, 000030, 000035, 000036 and 000037, while the following ten city-branches belong to group C: 000004, 000010, 000013, 000014, 000018, 000019, 000021, 000023, 000031 and 000034. The city-branch 000010 has no counter for transaction accounts, and the city-branches 000013 and 000014, despite the services on the counters for transaction accounts, conduct international payment for legal entities. In this paper the focus is on the last year of the observed period, i.e. 2011.

After developing the AHP model, a questionnaire was composed in which the respondents (Officers of the Analysis, Information and Support Office) were asked to do pair-wise comparison in each level of the hierarchy and to express their preferences using the intensity of importance scale. The respondents first had to compare the criteria that were given in pairs by using the option of importance (i.e. which one of the two criteria that are compared in a pair is more important for the goal – ranking the city-branches in the groups they belong to in the observed time frame) and afterwards express their preferences with the help of the Saaty's scale. Next, in the same questionnaire, the respondents had to compare the alternatives, i.e. the city-branches that were given in pairs in regards to each criterion, and on the basis of the data for the observed period, to use the option of priority (which of the two city-branches that are compared in a pair is given priority in regards to the criterion) and to express their preferences with the help of the same scale. The prepared questionnaire was quite huge (a total of 320 pages), so it represented a fairly complex task for the respondents. The mentioned questionnaire is not added as an appendix due to its size.

The questionnaire was sent to the respondents by e-mail, and after they filled it, they submitted the quastinnaire by e-mail, determining that the questionnaires were fully completed. The values that were given in the questionnaires by the respondents were entered in the programming tool Super Decisions (Super Decisions Software, 2006) for each group of city-branches separately. There are four ways of assessing the comparisons in pairs in this software tool: graphically, verbally, through a matrix, and through a questionnaire. The data from the questionnaires that were filled by the respondents were entered in the tool Super Decisions through the choice of questionnaire. The obtained results i.e. the weights of the criteria and priorities of alternatives, are presented and analyzed below.

The weights of the criteria are shown in Figure 2. It can be seen from this Figure that only one criterion, i.e. the criterion of public services has a weight 0.045455, while the remaining seven criteria have same weight (0.136364).

The priorities of the alternatives that belong to groups A, B and C are shown in Figures 3, 4 and 5 respectively. The Consistency Ratio (CR) in all of the analyzed cases is 0.01 and it follows that the results are consistent.

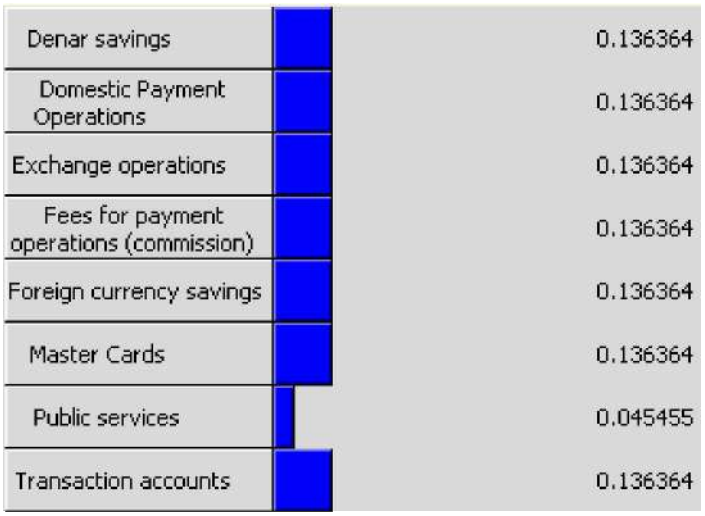


Figure 2: Weights of criteria

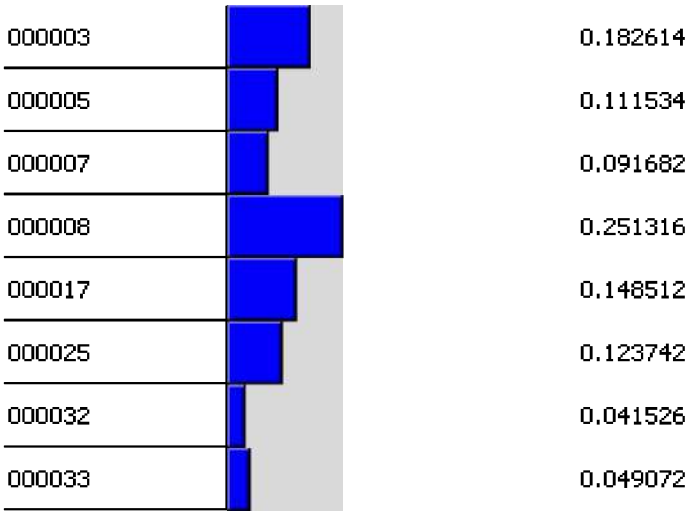


Figure 3: Priorities of city-branches that belong to group A

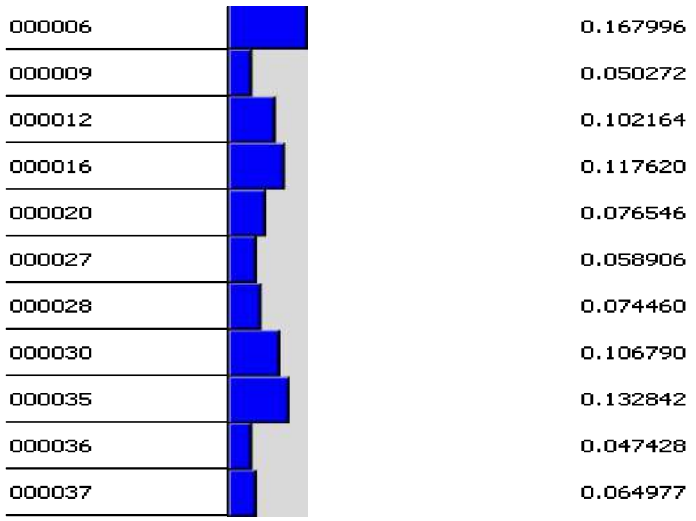


Figure 4: Priorities of city-branches that belong to group B

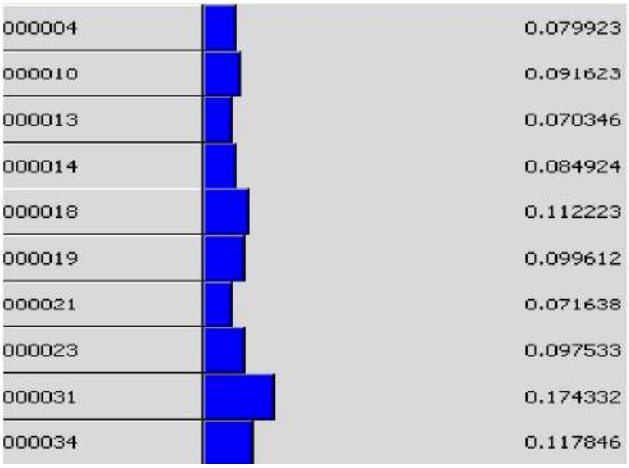


Figure 5: Priorities of city-branches that belong to group C

Based on the priorities of the city-branches their ranking is performed in the groups in which they belong (Table 3). It can be seen from this Table that in group A the highest ranked city-branch is 000008, followed by the city-branch 000003, while the lowest ranked branch is 000032. In group B, the highest ranked city-branch is 000006, followed by the city-branch 000035, while the lowest ranked city-branch is 000036. In group C, the highest ranked city-branch is 000031, followed by the city-branch 000034, and the lowest ranked city-branch is 000013.

Table 3: Rank of the city-branches of Commercial bank AD Skopje

City-branches that belong to group A	Rank	City-branches that belong to group B	Rank	City-branches that belong to group C	Rank
000003	2	000006	1	000004	8
000005	5	000009	10	000010	6
000007	6	000012	5	000013	10
000008	1	000016	3	000014	7
000017	3	000020	6	000018	3
000025	4	000027	9	000019	4
000032	8	000028	7	000021	9
000033	7	000030	4	000023	5
		000035	2	000031	1
		000036	11	000034	2
		000037	8		

7. SENSITIVITY ANALYSIS

Sensitivity analysis offers a stable solution and it enables change of inputs in order to observe the consequences on outputs, i.e. the priorities of the alternatives (Begicevic, Divjak & Hunjak, 2007). In order for a sensitivity analysis to be performed, the programming tool Expert Choice (Expert Choice, 2005) has been used. This tool contains the following five options for a sensitivity analysis: 1. Performance; 2. Dynamic; 3. Gradient; 4. Head to Head and 5. 2 D.

Most interesting for analysis are the three top ranked city-branches from each group for 2011, and also there have been chosen three criteria. Out of the eight criteria, seven of them are equally important for each model, hence resulting in a combination of three criteria (if the criteria had a different importance, then it would have been suitable to choose the three criteria that have the highest weights). Such an approach, with three criteria and three alternatives, could have been realized in the trial version of the Expert Choice software, for which access was given, while in the models that were created in Expert Choice, data from the filled questionnaires by the respondents were used.

For the first AHP model, in which the city-branches that belong to group A are ranked, the top ranked have been chosen to be the city-branches: 000008, 000003 and 000017; the criteria being: foreign currency savings, exchange operations, and domestic payment operations. For the purpose of comparing the elements of the hierarchy in pairs, the data from the filled questionnaires by the respondents were used

(explained in Section 6). The weight for each of the criteria is 0.333, while for the alternatives 000008, 000003 and 000017, the overall priorities are 0.483, 0.297 and 0.220, respectively.

Figure 6 is created through choosing the option of Performance from the menu Sensitivity-Graphs of the Expert Choice software. The weights of each criterion and the ranking of the city-branches can be seen in it. Additionally, the order of the three city-branches for each criterion can be seen through this option. In regards to the criterion on foreign currency savings, the city-branches 000008 and 000003 are equally preferred, while regarding the other two criteria, the most preferred is the city-branch 000008. In order to see how the change of the input data (criteria) will reflect on the final results, there has been made a change of the importance of the criterion of foreign currency savings (because of the above-mentioned statement for both the alternatives that are highly ranked), so its importance has increased by 20%, which has seen a slight decrease in the overall priority of the city-branch 000008, a slight increase in the overall priority of the city-branch 000003, the city-branch 000017 having no changes, and the ranking of the city-branches stays the same. In addition, the importance of the criterion of foreign currency savings has changed (from 33.3% increasing to 60%), but there have been no changes in the ranking. Figure 6 also displays the alternatives 000003 and 000017 as being equally preferred in regards to the criterion of exchange operations, and its importance has changed as well to: 40%, 50%, and 60%, but once again, the ranking of the city-branches does not change.

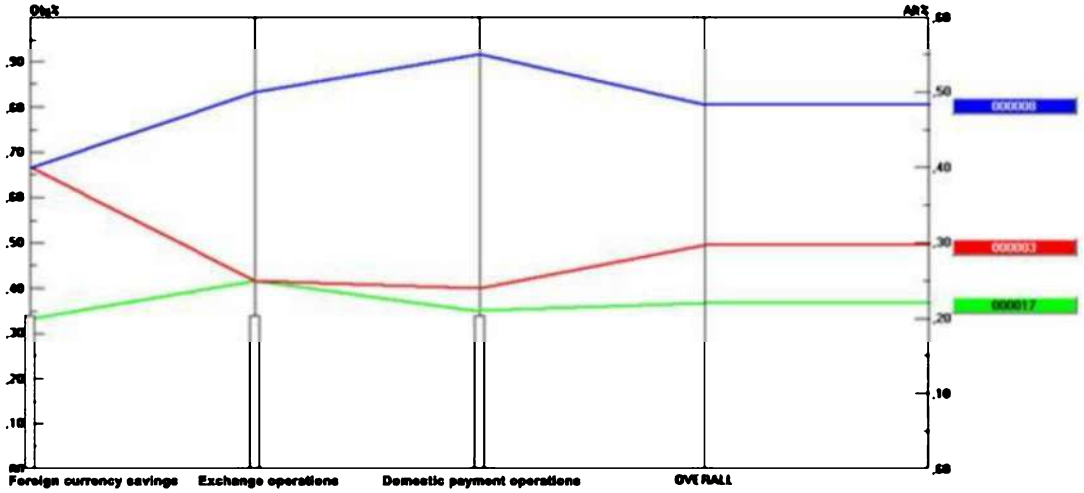


Figure 6: Sensitivity analysis - option Performance for the first AHP model

Through the option of Gradient, one can notice the sensitivity of the overall priorities of the city-branches 000008, 000003 and 000017 on the change of the importance of each criterion separately. The red vertical line shows how large the weight is for the chosen criterion. Figure 7 displays the conclusion that if the weight of the criterion of foreign currency savings increases, there is a decrease in the priority of city-branch 000008, an increase in the priority of city-branch 000003, while the priority of city-branch 000017 does not undergo significant changes.

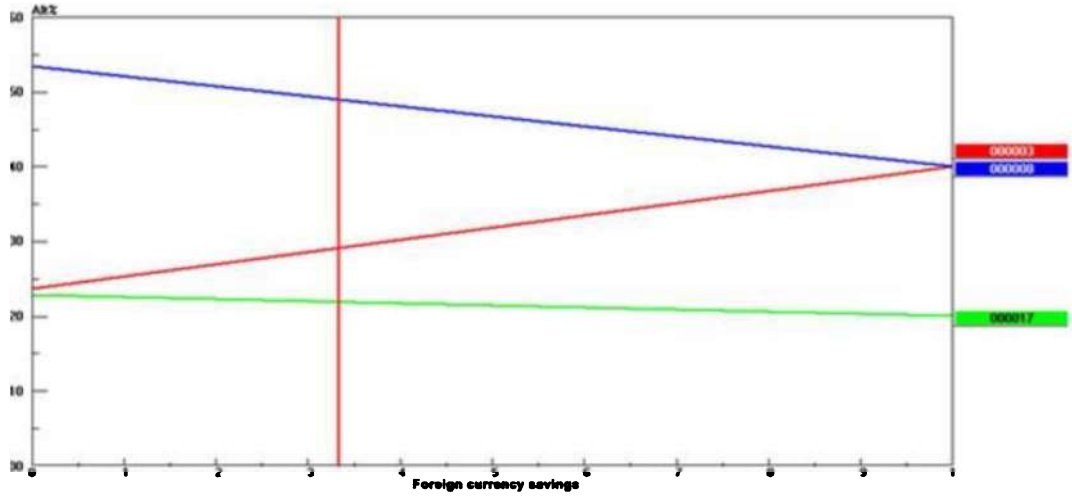


Figure 7: Sensitivity analysis - option Gradient for the criterion of foreign currency savings for the first AHP model

The option of Head-to-head is followed for one pair of city-branches (000017 and 000003). Figure 8 shows that the city-branch 000003 has an advantage over city-branch 000017, regarding the criteria: foreign currency savings and payment operations. What can be noticed in addition is that the weighed advantage of the city-branch 000003 (the gray triangle oriented towards the right) over city-branch 000017 is not considerably high.

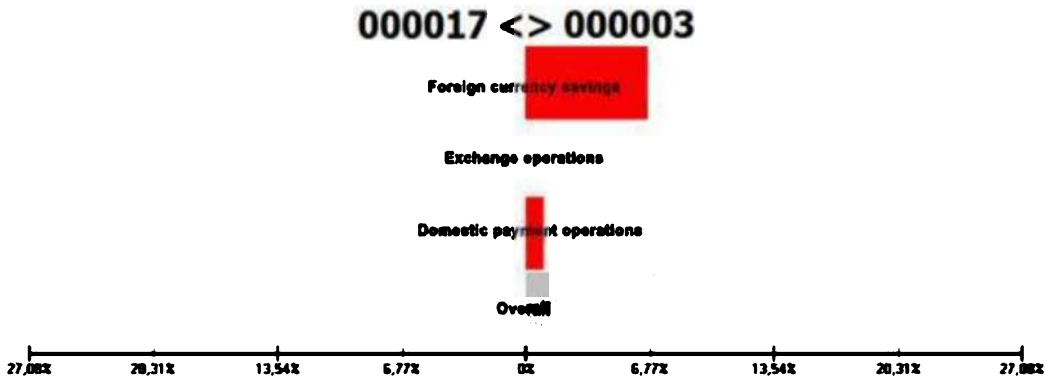


Figure 8: Sensitivity analysis - option Head-to-head for the city-branches: 000017 and 000003

In addition, the sensitivity analysis through the option of 2D is explained. In regards to the chosen criteria: foreign currency savings and exchange operation, the top city-branch is 000008 (Figure 9), and for its advantage over city-branch 00003 the contriubting criterion is exchange operations. City-branches 000003 and 000017 have the same priority in regards to the criterion of exchange operations, but when we take into consideration the criterion of foreign currency savings, then city-branch 000003 is in advantag

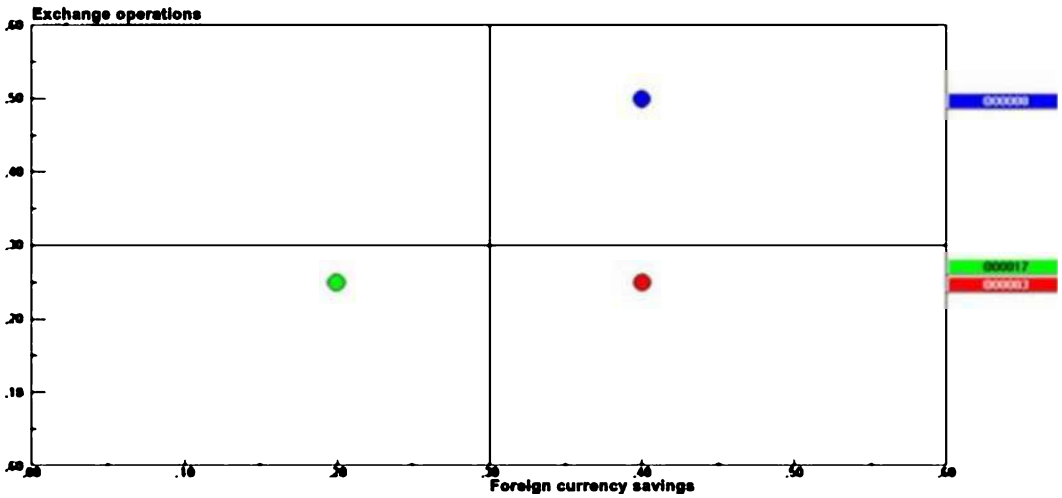


Figure 9: Sensitivity analysis - option 2D for the criteria: foreign currency savings and exchange operations for the first AHP model

For the purpose of analyzing whether the ranking of the three city-branches from Group A is stable, a sensitivity analysis is conducted, through the option of Dynamic, with the significance of each criteria separately increased by 5%. On the basis of the analyzed results it has been concluded that with the increase of the significance of the criteria by 5%, the ranking of the three city-branches from Group A is stable.

For the second AHP model, which ranks the city-branches that are part of Group B, the three top ranking city-branches for 2011 have been distinguished: 000006, 000035 and 000016. At the same time, the following three criteria have been chosen: denar savings, master cards and commission. For the third AHP model, which ranks the city-branches that belong to Group B, the three top ranked city-branches for 2011 have been chosen (000031, 000034 and 000018), while the criteria chosen are: denar savings, foreign currency savings and transaction accounts. In order to analyze whether the ranking of the three city-branches of Groups B and C is stable, a sensitivity analysis has been conducted, through the option of Dynamic, thus concluding that the ranking is stable.

8. CONCLUSION

The AHP can be applied for solving numerous MCDM problems (planning, optimizing, measuring performances, resource allocation, conflict solving, etc.). Through the conducted research presented in this paper, the following scientific contributions have been achieved: the AHP model for ranking the city-branches of a bank was developed and it was validated on the case of Komercijalna Banka AD Skopje. In our experience, the developed AHP model has strongly motivated all of the respondents (experts in banking) because their knowledge and preferences were incorporated in it. The developed AHP model with obtained weights of criteria can be used for prioritization of the city-branches of banks in general. The benefits of using this model are: the calculation of weights of criteria for ranking the city-branches can help bank managers to be more objective in the process of ranking; the ranking procedure is more transparent and simpler; better quality in decision-making at city-branches; improving the performance of city-branches that has a positive influence on the successful operating of the bank in which they belong to. In our further research we plan to develop generic AHP model for comparison of city-branches, as well as to use statistical methods for defining criteria. We will also try to develop the ANP (Analytic Network Process) model for ranking city-branches of the bank.

REFERENCES

Aamodt, A. & Plaza, E. (1994). Case-based reasoning: Foundational issues, methodological variations, and system approaches. *AI Communications*, 7(1), 39-59.

Arbel, A. & Orgler, Y.E. (1990). An application of the AHP to bank strategic planning: The mergers and acquisitions process. *European Journal of Operational Research*, 48(1), 27-37.

Begicevic, N, Divjak, B. & Hunjak, T. (2011). AHP-based group decision making using keypads. *International Journal of Economics and Business Research*, 3(4), 443-458.

Begicevic, N., Divjak, B. & Hunjak, T. (2007). Prioritization of e-learning forms: a multicriteria methodology. *Central European Journal of Operations Research*, 15(4), 405-419.

Brans, J. P., Mareschal, B. & Vincke Ph. (1984). PROMETHEE: A new family of outranking methods in multicriteria analysis. In: J. P. Brans (Ed.), Operational Research, IFORS 84 (291-302). Amsterdam: North Holland.

Charnes, A, Cooper, W. W. & Ferguson, R. O. (1955). Optimal estimation of executive compensation by linear programming. *Management Science*, 1(2), 138-151.

Charnes, A, Cooper, W. W. & Rhodes, E. L. (1978). Measuring efficiency of decision making units. *European Journal of Operational Research*, 2(6), 429-444

Cooper, W. W, Seiford, L. M. & Tone, K. (2007). *Data envelopment analysis: A comprehensive text with models, applications, references and DEA-solver software*. (2nd ed.). New York: Springer Science + Business Media, LLC.

Edwards, W. (1971). Social utilities. *Engineering Economist (Summer Symposium Series)*, 6, 119-129.

Edwards, W. (1977). How to use multiattribute utility measurement for social decision making. *IEEE Transactions on Systems, Man and Cybernetics*, 7, 326-340.

Expert Choice, Inc. (2005). http://www.expertchoice.com/ [Accessed in March and May, 2012].

Fishburn, P. (1967). Conjoint measurement in utility theory with incomplete product sets. *Journal of Mathematical Psychology*, 4(1), 104-119.

Haghighi, M, Divandari, A. & Keimas, M. (2010). The impact of 3D e-readiness on e-banking development in Iran: A fuzzy AHP analysis. *Expert Systems with Applications*, 37(6), 4084-4093.

Hwang, C. L. & Yoon, K. (1981). *Multiple attribute decision making methods and applications: A state of the art survey*. New York: Springer-Verlag.

Hwang, C.L., Lai, Y.J. & Liu, T.Y. (1993). A new approach for multiple objective decision making. *Computers and Operational Research*, 20(8), 889-899.

Javalgi, R.G, Armacost, R.L. & Hosseini, J.C. (1989). Using the analytic hierarchy process for bank management: Analysis of consumer bank selection decisions. *Journal of Business Research*, 19(1), 33-49.

Keeney, R. & Fishburn, P. (1974). Seven independence concepts and continuous multiattribute utility functions. *Journal of Mathematical Psychology*, 11(3), 294-327.

Keeney, R. (1977). The art of assessing multiattribute utility functions. *Organizational Behavior and Human Performance*, 19(2), 267-310.

Mardani et al. (2015). Multiple criteria decision-making techniques and their applications – a review of the literature from 2000 to 2014. *Economic Research-Ekonomska Istrazivanja*, 28(1), 516-571.

Nasrabadi, S.N, Fallah, E. & Hasanzadeh, A. (2014). Application of analytical hierarchy process (AHP) to rank selected branches of Sina bank from the perspective of e-banking. *Interdisciplinary Journal of Contemporary Research in Business*, 6(1), 222-232.

Onder, E, Tas, N. & Hepsen, A. (2013). Performance evaluation of Turkish banks using analytical hierarchy process and TOPSIS method. *Journal of International Scientific Publication: Economy & Business*, 7(1), 470-503.

Rezaei et al. (2013). Effective factors on optimizing banks' balance sheet using fuzzy analytical hierarchy process. *Management Science Letters*, 3(11), 2781-2786.

Roy, B. & Bertier, P. (1973). La methode Electre II: Une application au media planning. In M. Ross (Ed.), *Operational Research 1972* (pp. 291-302). Amsterdam: North Holland Publishing Company.

Roy, B. & Bouyssou D. (1993). Aide multicritere a la decision: Methodes et cas. economica.

Roy, B. & Huggonard, J.-.C.H.R. (1982). Ranking of suburban line extension projects of the Paris metro system by a multicriteria method. *Transportation Research*, 16A(4), 301-312.

Roy, B. (1968). Classement et choix en presence de points de vue multiples (la methode Electre). *Revue Francaise d'Informatique et de Recherche Operationnelle*, 8(1), 516-571.

Roy, B. (1978). Electre III: un algorithme de classement fonde sur une representation floue des preferences en presence de criteres multiples. *Cahires du CERO* , 20(1), 3-24.

Roy, B. (2005). Paradigms and challenges. In Figueira, J, Greco, S. & Ehrgott, M. (Eds), *Multiplecritera decision analysis: State of the arts surveys* (pp. 3-24). New York: Springer.

Roy, B. & Skalka, M. (1984, February). Electre IS: Aspects methodologiques et guide d'utilisation. *Document Du LAMSADE*, 125.

Saaty, T. L. (1977). A scaling method for priorities in hierarchical structures. *Journal of Mathematical Psychology*, 15(3), 234-281.

Saaty, T. L. (1980). *Multicriteria decision making: The analytic hierarchy process*. Pittsburgh: RWS Publications.

Saaty, T.L. & Begicevic, N. (2010). The scope of human values and human activities in decision making. *Applied Soft Computing*, 10(4), 963-974.

Saaty, T.L. & Vargas, L. (2012). *Models, methods, concepts and applications of the analytic hierarchy process*. (2nd ed.). New York: Springer Science+Business Media.

Saaty, T.L. (2001). *Decision making in complex environments. The analytic network process for decision making with dependence and feedback*. Pittsburgh: RWS Publications.

Super Decisions Software (2006). http://www.superdecisions.com/ [Accessed in March, April and May, 2012].

Thanassoulis, E. (2001). *Introduction to the theory and application of data envelopment analysis: A foundation text with integrated software*. Boston: Kluwer Academic Publishers.

Velasquez, M. & Hester, P. T. (2013). An analysis of multi-criteria decision making methods. *International Journal of Operations Research*, 10(2), 56-66.

Xie, W. & Gong, H. (2008). Using fuzzy analytic hierarchy process and balanced scorecard for commercial bank performance assessment. In ISBIM'08 Proceedings of the 2008 International Seminar on Business and Information Management (pp. 432-435). Washington: IEEE.

Yoon, K. (1987). A reconciliation among discrete compromise situations. *Journal of Operational Research Society*, 38(3), 272-286.

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

ELECTRONIC BUSINESS 255

E-BUSINESS START-UP MODELS 256
Malbašić Una, Surla Katarina

MEASURING DEMAND FOR IT SKILLS ON THE SERBIAN JOB MARKET 265
Vujović Stefan, Đorđević Valentina, Barać Dušan

TRENDS SHAPING BUSINESS MODEL INNOVATION IN TELECOMMUNICATION COMPANIES 270
Orlić Nenad, Vasković Vojkan

RESHAPING THE FUTURE OF BUSINESS PROCESS MANAGEMENT THROUGH SUSTAINABLE CONTENT MANAGEMENT SYSTEM 279
Milenkovic S. Dejan, Jovanovic Milenkovic Marina, Simonovic Dragoljub

STAKEHOLDER RELATIONSHIP MANAGEMENT IN E-BUSINESS OF LARGE ENTERPRISES 285
Milinović Suzana , Vasiljević Dragana, Despotović-Zrakić Marijana

IMPLEMENTATION OF QUALIFIED ELECTRONIC SIGNATURE IN THE PROCESS OF CREATING TECHNICAL DOCUMENTATION 297
Novarlić Miljana, Martać Rastko

MANAGEMENT INFORMATION SYSTEMS: E-LEARNING AT THE UNIVERSITY OF NOVI SAD 298
Marjanovic Ugljesa, Tasic Nemanja, Lalic Bojan

IMPLEMENTATION OF THE CROWDFUNDING CONCEPT IN HIGHER EDUCATION 304
Staletić Nada, Petrović Vera

ILS LEARNING STYLE MODEL AND MULTIMEDIA E-LEARNING 312
Radosavljević Vitomir, Mamula Tartalja Danica, Jelić Gordana

CRM MODEL IN E-BUSINESS FOR NON-COMMERCIAL ONLINE RADIO 318
Badovinac Nenad, Đorđević Katarina

WEB SITE INTEGRATION INTO ORGANAIZATIONAL STRUCTURE OF THE LOCAL TOURIST COMMUNITY 324
Vasković Jelena, Bačević Miloš

APPROACH TO COLLABORATIVE MICROLEARNINGBASED ON CROWDSOURCING 329
Zahirović Suhonjić Anida, Labus Aleksandra, Despotović-Zrakić Marijana

AUGMENTED REALITY AND MOBILE LEARNING 338
Štrbac Slavica, Grgurović Biljana, Radosavljević Vitomir

SEMANTIC MODEL FOR ADAPTIVE E-LEARNING SYSTEMS 345
Perišić Jasmina, Bogdanović Zorica, Đurić Igor

SUCCESS FACTORS FOR LUXURY BRANDS IN E-BUSINESS: BURBERRY CASE STUDY 354
Radisavljevic Tijana, Markovic Aleksandar

DIGITAL MARKETING AND SOCIAL MEDIA IN HIGHER EDUCATION 365
Vujin Jovana

ANALYSIS AND VALIDATION OF SUCCESS FACTORS OF MOBILE APPLICATIONS AS E-MARKETING TACTIC 372
Đurđević Natasa

E-SERVICES IN THE REGULATION OF MEDICINES AND MEDICAL DEVICES 380
Stojadinovic Tatjana, Vanevski Igor, Radovanovic Ljiljana

INTERNET OF THINGS IN E-HEALTH: APPLICATION OF WEARABLES FOR STRESS MANAGEMENT 387
Rodic Trmcic Branka, Labus Aleksandra, Radenkovic Bozidar

AN APPLICATION OF INTERNET OF THINGS: MEASURING TRAFFIC FLOW 396
Jezdović Ivan, Ivković Aleksandar, Matejić Sanja

INTELLIGENT PARKING SERVICE MODEL 402
Vuletic Predrag, Bojovic Zivko

AN APPLICATION OF TEXT TO SPEECH IN SMART HOME 408
Knežević Đorđe, Lošić Pavle, Bojović Živko

SMART BUILDING, THE NATIONAL BANK OF SERBIA 415
Bjelobaba Goran, Savić Ana

AMBIENT INTELLIGENCE TOOL FOR MULTIMEDIA USER PROFILING 424
Đurić Igor, Bogdanović Zorica, Radenković Božidar

USING BIG DATA ON LARGE DAMS 432
Martać Rastko, Novarlić Miljana, Barać Dušan

TRAFFIC FLOW WEB MONITORING BASED ON THE MONGODB 439
Zdravković Stefan, Vulović Nikola,Stanković Ranka

THE POTENTIAL OF BIG DATA IN HEALTH SYSTEM 446
Jovanovic Milenkovic Marina, Milenkovic Dejan, Vukmirovic Aleksandra

IMPROVING E-COMMERCE SYSTEMS WITH BIG DATA TECHNOLOGY 452
Stojić Nenad, Dacić-Pilčević Aleksandra

BIG DATA IN POSTAL TRAFFIC AND POSSIBILITIES OF USE 458
Dupljanin Đorđije, Dumnić Slaviša, Atanasković Predrag

COMPARATIVE OVERVIEW OF JAVASCRIPT FRAMEWORKS USED IN E-BUSINESS APPLICATIONS 464
Zdravković Dušan

ELECTRONIC BUSINESS

E-BUSINESS START-UP MODELS

Una Malbašić*[1], Katarina Surla[1]
[1]Faculty of Organizational Sciences
*Corresponding author, e-mail: una.malbasic@gmail.com

Abstract: *This paper presents opportunities of implementation of Canvas Business Model in e-business planning. Canvas has become an important tool for entrepreneurs nowadays. The advantages of this model are numerous. Therefore, the aim of the paper is to introduce the possibilities and benefits of using such model. Canvas Business Model can be used for new business ideas and for analysis of existing ones. There are several adaptations of this model, such as Lean Canvas. Lean Canvas is business model used for start-ups and mostly on-line business. The second part of this paper gives the examples and first steps for implementation of both models in electronic business start-up. Considering mentioned examples, this research can be used as a guide for future entrepreneurs in business model creation and the main objective reflects in ensuring that process of business development is concisely and clearly demonstrated including the crucial application steps. This model focuses on the key segments of a business. Moreover, it enables its users to define strengths and pain points and to understand them.*

Keywords*: canvas, business, model, lean, start-up, entrepreneurship*

1. INTRODUCTION

Business model presents conceptual tool containing a set of objects, concepts and their relationships with the objective to express the business logic of a specific business. (Pateli and Giaglis 2003). This concept was firstly introduced in 1957 in article written by Bellman. However, the academic research on this topic started in 1990s, and since then it intrigued numerous academics, scientists, businesspeople and entrepreneurs. It has become particularly popular in, what is known as, dotcom boom and it is thought that poor business models actually led to downfall of lot of e-business companies of that time. Globalization, uncertainty and ICT environment have contributed to the growing popularity of this concept, especially in the e-business industry.
Electronic business represents the conduction of business processes on the Internet. Business processes include buying and selling products, servicing customers, processing payments, collaborating with business partners, sharing information, running automated employee services, etc. (Radenković, Despotović-Zrakić, Bogdanović, Barać, Labus, 2015)

In e-business, information and communications technology is used to enhance business. It includes any process that a business organization conducts over a computer-mediated network. E-business can be described as transformation of organizational processes in order to deliver additional value through implementation of technologies and computing paradigm of trending economy (Lee, 2009).
Primary processes that are enhanced in e-business:

- Production processes, which include procurement, ordering and replenishment of stocks; processing of payments; electronic links with suppliers; and production control processes.
- Customer-focused processes, which include promotional and marketing efforts, selling over the Internet, processing of customers' purchase orders and payments, and customer support, among others; and
- Internal management processes, which include employee services, training, internal information-sharing, video-conferencing, and recruiting. Electronic applications enhance information flow between production and sales forces to improve sales force productivity. Workgroup communications and electronic publishing of internal business information are likewise made more efficient

The aim of this paper is to demonstrate how business model can be used in developing new business. In order to increase the understanding of this process and to provide steps and tools for its implementation, the service provider start-up will be used as an example..

Starting business on the internet is a good way to realize entrepreneurial idea, especially if it is cost consuming and requires significant investments. There are multiple ways to start business online, including selling products, creating an affiliate site that has a functional store, drop shipping for a merchant or starting an information publishing business (Chhabra, 2013). All of these methods have their own set of

advantages and disadvantages, which is the crucial reason to determine business goals before deciding on a model.

2. E-BUSINESS MODELS FOR START-UPS

The first step in e business development (regardless is it an e-business) is to create detailed business plan. One of the purposes of a clear business plan is to have all steps, ideas, hints and goals identified and transparent. In practice, for most business, plan should reflect focus strategy, resources and their responsibilities matrix, the financial projections of cash flows and necessary investments sales forecasts and marketing strategy. (Dollinger, 2003)
The plan helps the founders to distinguish meaningful pieces related to projected expense, sales, timing of payments. Its focus is definition of business purpose, how the goals are going to be achieved and why the founders are the right people for this business. Also, details regarding the financial resources necessary for progress and timeline of the growth phases that will lead to profitability are important step.
Bullet points that should be included and elaborated in every business plan are:

- Executive summary – it should reflect the key highlights of the plan
- Products and services - core of business purpose
- Management team - should include relevant team review that explain why management personnel are the right people for their jobs
- Market research and clear definition of target niche. Also, it is important to identify possible competition.
- Quality Strategy
- Milestones and Metrics – key metrics that will be used to track the growth and progress of business in question
- Financial Plan – the most critical component. It should include : Sales Forecast, Personnel Plan, Profit & Loss Statement, Cash Flow Statement and Balance Sheet
- Risk Management
- Continuity Plan

Simultaneously, it is necessary to define business model which must be implemented in process of business planning. The main difference between business plan and business model can be explained by following definition. The business model is the mechanism through which the company generates its profit while the business plan is a document presenting the company's strategy and expected financial performance for the years to come. The business model is the center of the business plan. (Neilson, Pasternack, 2005)
Model describes how the company is positioned within its industry's value chain, how it organizes its relations with its suppliers, clients, and partners and how it manages money flows in order to generate profits. On the contrary, he business plan translates this positioning in a series of strategic actions and quantifies their financial impact. Nowadays business models can be divided in “basic models” and “new models”. Basic models assume that companies compete either on price or non-price components. New business models are based on innovative organization forms and/or new products or services, mostly in electronic business area (Daidj, 2014).Academic research on business models has started in late 1990s, and since then numerous definitions emerged. One of the first was written by Timmers in 1998. Timmers defines a business model as a three part concept “(a)an architecture for the product, service and information flows, including a description of the various business actors and their roles; and (b) a description of the potential benefits for the various business actors; and (c) a description of the sources of revenues.”

Every company has a business model, whether that model is explicitly articulated or not (Chesbrough, 2006; Teece, 2010).

In 2005 Morris et al. proposed new definition which says that “A business model is a concise representation of how an interrelated set of decision variables in the areas of venture strategy, architecture, and economics are addressed to create sustainable competitive advantage in defined markets”. (Morris, Minet, Richardson, Allen, 2006)

Similarly, at the same year, Shafer at al presented his definition: “We define a business model as a representation of a firm’s underlying core logic and strategic choices for creating and capturing value within a value network.” (Shafer, Smith, Linder, 2005).

In recent years, George and Bock defined business model as the design of organizational structures to accomplish a commercial opportunity. They also mention three dimensions to the organizational structures: resource structure, transactive structure, and value structure (George, Bock, 2011).

The business model concept defines how a firm creates and captures value for its stakeholders (Amit and Zott, 2001).
Despite countless definitions, researchers have not yet come up with a general one. The reason can be found in diverse implementations of business model. Regarding e-business models, authors agree on key characteristics of model, but focus is different. Nowadays, most often used models are: Canvas and Lean Canvas.

2.1. Canvas business model

The Business Model Canvas is strategic management and entrepreneurial tool. (Osterwalder, Pignegur, 2010) It is well-known business model, used in order to highlight the key segments of a business. The model describes the most relevant parts of business plan and helps its users to focus on values for its enterprise. The purpose of Canvas is to point out how an organization creates, delivers, and captures value. (Osterwalder, Pignegur, 2010) It is widely used among entrepreneurs both for business plan creation and analysis. Canvas was created in 2008 by creator Alexander Osterwalder. and he created it in 2008 Since thean, a lot of numerous versions of Canvas Business Model emerged (Coes, 2014). Boris Shiskov compares Business Model Canvas to the Value Map in his book "Business Modeling and System Design ". He recognizes Canvas as one of the most established methods in industry for business design, innovation and creation. (Shiskov, 2014) Today's market is uncertain and driven by factors beyond one's control: demographic changes, recession, environmental issues, increasing global competition. These factors are beyond control of most companies, but they and their business models are affected by them. Therefore, companies cannot change the environment, but they can change the way they operate and the models they use. (Clark, Osterwalder, Pignegur, 2012)

Canvas Business model is a tool consisted of nine segments known as building blocks.
Nine main elements and also referred as key drivers of Business Model Canvas are:

- Customer Segments
- Value Propositions
- Channels
- Customer Relationships
- Revenue Streams
- Key Activities
- Key Resources
- Key Partnerships
- Cost Structure

These elements can be clustered in few groups: Value which includes value proposition, Relationships (including Channels, Customer Relationships, Key Partnerships and Customer Segments), activities (Key activities and key resources) and financial aspects (cost structure, revenue streams). Each segment needs to be filled in with answers to key questions. It is important to have in mind the main goal while filling the blocks. However, it is necessary to avoid any overlapping in defined questions and answers.

- Customer Segments (CS) - This building block defines the different groups of people or organizations a business plans to serve. A customer groups have to be carefully and precisely defined since there can be overlapping in some segments.

- Value Propositions (VP) - The Value Propositions summarizes all reasons and advantages of buying a product or using a service for specific consumer segment. The Value Propositions may be quantitative (example: lowest prices, speed of service) or qualitative (design, customer experience). This statement should point out why that one particular product or service will be the best choice in each aspect, what problem it solves and what is the value it delivers.

- Channels (CH) - This building block is used to show how a company communicates to its customers. Also in this part of a model it is important to explain how company plans to reach its consumers in order to deliver their Value Proposition. Channels are directed toward distribution, sales and communication activities.

- Customer Relationships (CR) - This block is used to describe what kind of relationships a business builds with key customers. This element includes personal interactions (such as one on one meeting), customized relations (mass customization), automated relationships (reviews, comments, and generic replies). This element influences the value propositions and thus overall customer experience.

- Revenue Streams (RS) - The revenue streams show how a company earns income and generates profit from its business. In this part it is described how each customer segment contributes to revenue and profit. Revenue streams can be classified and calculated differently. Usually there are two basic types: revenues from singular transactions and repeated transactions (monthly, yearly or other subscription). The focus in this building block is on calculation of customers' willingness to pay for a product/service.

- Key Resources (KR) - The most important assets which are crucial and irreplaceable for the business are key resources. Those resources can include intellectual resources, financial, physical or human resources. It is hard to define all key resources, but it is of utmost importance for business maintenance.

- Key Activities (KA) - Key activities represent the most important processes and activities the company has to undertake in order to make it business work. The important thing in this block is to list and define all the activities regarding other building blocks such as necessary operations to create Value Propositions, reach Customers, maintain Relationships, promote the product or service, upgrade values, reduces costs and earn revenues. and earn revenues.

- Key Partnerships (KP) - This block represents the stakeholders that make business model work. That is usually network, created among employees, business partners, suppliers, organizations, government and clients. Partnerships are essential in order to gain benefits and help build position on the market. Choosing the right partner can reduce the risks, expenses and it can enable acquisition of specific resources or activities which cannot be produced by the business itself.

- Cost structure (CS) - Cost structure describes all costs and expenses which occur in activities undertook in a specific business. Those costs can be created while creating value, maintaining partnership relations etc.

2.2. Lean Canvas business model

Lean Canvas is an adaptation of Business Model Canvas, but it is created primarily for new start-up business. It is often referred as a problem-solution oriented approach because of its structure and focus. The building blocks in this business model are somewhat different. The focus is on product and market.
This method is always associated with entrepreneurs and start-ups. The author of the book The Lean Start-up, says that The Lean Startup method teaches one how to start a start-up, how to drive it, when to turn, when to protect and how to grow a business with maximum acceleration (Ries, 2011). Moreover, it is often said that Lean Canvas is the model that helps identify risky parts of a business and find the right solutions in various learning cycles. (Croll and Yoskovitz, 2013) When using this tool, it is important to follow predefined order of actions. Some blocks have to be completed in pairs because they are correlated. It is important to use this model following predefined order of actions and to fill blocks in the bellow written order (Mohapatra, 2013).
Building blocks in Lean Canvas: Problem, Customer Segments, Unique Value Proposition, Solution, Channels, Cost Structure, Revenue Streams, Key Metrics and Unfair Advantage.
They can be divided in two groups, as mentioned: Product and Market. Some of the blocks are the same as in the Business Model Canvas. The different ones are: Problem, Solution, Key Metrics Unfair Advantage, and they will be further explained.

- Problem

In this block it is necessary to list few problems which can be related to the customer segments. Key question for this block is "What is one's problem and does it have a problem worth solving?" It is important to figure if the solution exists before investing time in defining it. The usual number of problems listed is three.

- Solution

Solution block needs to be fill in with solutions to the problems listed before. Each solution needs to address appropriate problem.

- Key Metrics

The key metrics in Lean Canvas model are the activities that move business forward.

- Unfair advantage

Unfair advantage represents something that cannot be copied or bought. This block is very often mixed with unique value proposition. The difference between these two blocks is who they address. The Unique Value Proposition applies to the consumers and unfair advantage to competitors.

3. EXAMPLES OF IMPLEMENTATION OF BUSINESS MODELS

3.1. Canvas in practice

The project "pickwith.us" represents software solution in hospitality services area. It is designed to make easier for users to discover and book place in every restaurant in Belgrade.
The main purpose of pickwith.us portal is to provide easier restaurants booking. It allows users to choose the appropriate restaurant based on desired parameters such as time, date, menu, location, price range etc. In order to book a table, it is required to create account with basic information. The process is simple and intuitive. Users of this portal can be divided in two groups: restaurant owners and guests. There are benefits for both user groups which will be described in Canvas business model.

Users of this portal are both owners of restaurants and guests. There are benefits for both user groups which will be described in Canvas business model.

Mission is to create universal environment which contains all information about restaurants in Belgrade and to attract both tourists and citizens.

Vision is to be the leader in providing new services on the market, in terms of integrated online booking in the multiple restaurants. Also, to fulfill customers' needs by providing accurate information, educative and interesting contents and to maintain strong relations with partners.

Table 1 : Canvas business model

<table>
<tr><th>Who are your key partners?</th><th>What are your key activities?</th><th>What are your value propositions?</th><th>Your customer relationships?</th><th>Customer segments?</th></tr>
<tr><td rowspan="2">Restaurant owners
Companies
Influential individuals</td><td>Negotiation with partners
Marketing activities
Improvement of service</td><td rowspan="3">Fast, simple and user-friendly process of making reservations
Reducing the time dedicated to processing booking requests
Marketing and promotion</td><td>Reviews
Marketing
Personal relationships
Mass customization</td><td rowspan="5">Citizens
Tourists
Organizations
Companies and employees</td></tr>
<tr><td>Key resources?</td><td>Channels</td></tr>
<tr><td rowspan="3">Project team
Developers
Equipment
Portal
Phone
Mail</td><td rowspan="3">Website
Phone
One on one meetings
Mail</td></tr>
<tr><td>Cost structure</td><td>Revenue streams</td></tr>
<tr><td>Hosting and domain
Marketing
Administrative
Other expenses</td><td>Fixed percentage per transaction
Advertisements</td></tr>
</table>

- Customer Segments

In this project, there are few customer segments and each of them gains different benefits. We divided them in following groups: Belgrade citizens, Tourists, Companies and organizations and Restaurant owners

Belgrade citizens are primary segment because they are end users of the portal. It is important to engage them and to become a part of their routine. The benefits are reflected in: time saving, more information, wider choice.
Tourists are an important segment because they are willing to explore all options that a city offers. They rely on recommendations of other guests and they are looking for easiest way to be informed. Thus, benefits for them are: easier decision making, information, clear insight and cheaper and simpler booking process.
Companies and organizations represent corporate users which can use this service in order to find appropriate place for all kind of events they organize (including balance between restaurant capacity and their needs, menus and prices).
Restaurant owners are specific segment because they represent key for entering the market. They are main relation between end users and portal. Benefits for them are numerous: promotion, better organization, easier booking process, guests' database with useful information etc.

- Value Proposition

The value proposition relates to several benefits: fast, simple and user-friendly process of making reservations for portal users, reducing the time dedicated to processing booking requests for restaurants, reducing costs of marketing and promotion activities for restaurants owners, safe booking and availability of information (about time, free spots, menus, prices etc.)

- Channels

In this project, the main channel is portal. It is the key resource for establishing communication with users. Additionally, other web services such as engines, other websites, emails and social media are used. The phone and one on one meeting are part of communication channels, also. They are primary channel for reaching the restaurant owners.

- Customer Relationships

Pickwith.us portal is based on relationships built with customer segments. Relationships can be reflected in following: Reviews, Marketing, Personal relationships and Mass customization

Reviews are used to provide portal users with real-time and organic opinions. They can be useful for both parties: users can easily make decisions based on reviews, and restaurants can build reputation and improve their strategies.
From the "Pickwith.us" portal point of view, marketing is reflected in activities related to online publishing through Facebook and Google Adds. Google search engine and publishing on Display Network are part of portal strategy. Google search engine includes key words, such as: restaurants, Belgrade, lunch, reservation, contact etc. Moreover, the social networks will be used through Facebook page and moving forward end users of portal will spread a word about pickwith.us.
The partners rely on marketing using pickwith.us portal and its social network presence. The possibilities for promotion are numerous, from restaurant presentation on portal, published special offers and contents.
Mass customization refers to establishing strong relationship between users and restaurants through suggested choices based on customer preferences. Pickwith.us stores a database with information and historical data for every user and, by following their previous choices, gives proposals according to their style.
Also, restaurants can improve their rank on this website through personal relationships. They can point out themselves, increase their visibility and engagement through personalized offers and suggestions.

- Revenue streams

Revenues are expected from several sources. Primary source is paid promotion. Several packages are offered depending on chosen promotional activities such as: special offers, news, promotions on pickwith.us homepage, weekly newsletters, key updates, promotion on pickwith.us Facebook page.
The second source is a fixed monthly subscription made through portal.

- Key Resources

Key resources include project team, developers, portal, phone and mail. Project team is responsible for implementation of business plan, executing the idea, communication with stakeholders, monitoring revenue streams and costs, realization of promotion activities and overall daily duties. Developers

maintain portal and work on its improvements. They manage databases. Portal is the key resource because it is main role in project implementation. Phone and mail are main communication tools.

- Key Activities

Firstly, key activity is portal development and updates in line with trends. Secondly, negotiation with partners, the key activity necessary in order to create a database and content of the portal. Lastly, marketing activities followed by Improvement of service.

- Key Partnerships

In this project, three main partnership groups are: Restaurant owners, Companies and individuals

Restaurant owners through partnership with "Pickwith.us" portal increase number of their visitors, enhance online presence and with that, positively affect target audience awareness. Pickwith.us, as an intermediate between restaurants and guests, make the process of booking reservations simpler for both parties.
One of the groups are companies which tend to after a hard work of their employees provide them opportunity to socialize outside the workplace, with the aim of bringing together and spreading the team spirit within the team. Organization of team events, corporate parties, etc. can be reward and motivational tool for the employees, brings positive atmosphere and helps achieving company's goals.
Influential individuals can be key point for business growth. This group refers to public figures, people who can spread the information about new portal and indicate to its possibilities and positive effects. The aim is to attract influential individuals by presenting booking software solution and providing welcoming benefits which will have direct positive impact on promotion of the portal.

- Cost Structure

All cost items can be divided to fixed and variable ones, and they depend of numerous factors on a monthly basis. These are: Hosting and domain, Marketing, Administrative and Other expenses

Hosting and domain represent fixed cost item, which will be payed monthly. There are multiple providers with different packages. The provider should be chosen according to the best ratio of cost and benefits in terms of server space, bandwidth, price, number of subdomains, number of e-mail addresses. Goal is to define URL address, so that consolidated name with domain is easy to remember, but also interesting for users.
"Pickwith.us" project requires significant investments in marketing. Costs are variable and depend on a volume of advertisements, Google and Facebook adds, etc. Since viral marketing is an important part of marketing plan, part of the budget is dedicated to the promotion on the Facebook page.
Offline marketing costs include price of flyers that will be located in restaurants and labels on those objects.
Administrative costs are necessary for maintenance of daily operations and business activities. They are not directly nested in the production of services. These costs include staff salaries, rent, equipment costs, electricity and water bills, insurance, etc. Administrative costs are fixed and there is a limited scope in a ability to reduce them.
Other expenses refer to earmarked assets for unexpected costs which are likely to occur. Approximately, 8% of the planned expenditures will be intended for this cost item. The reasons that can initiate occurrence of unexpected costs are numerous, but they will be analyzed after every appearance, for future references and better planning process.

3.2. Lean Canvas in practice

Table 2 : Lean Canvas model

Problem	**Solution**	**What are your value propositions?**	**Unfair Advantage**	**Customer segments?**
Creating a network of restaurants that will be willing to pay for the service they used to get for free. Attract users and become part of their routine	Offering a free trial period for all partners in order to realize all the benefits. Creating digital marketing campaign targeting key audience.	Fast, simple and user-friendly process of making reservations Reducing the time dedicated to processing booking requests	Unique base of users and unique service on the market. Absence of a portal that provides the same set of services at once in Belgrade.	Citizens Tourists Organizations Companies and employees

The lack of a mobile version.	Including development of a mobile application in long term plan.		**Channels**	
	Key Metrics		Website Phone One on one meetings Mail	
	Number of sign-ups. Number of restaurants in the offer. Number of engagements on Facebook.			
Cost structure		**Revenue streams**		
Hosting and domain Marketing Administrative Other expenses		Income of paid post Fixed percentage per transaction Advertisements		

4. CONSLUSION

This paper presents guidelines for both future entrepreneurs who intend to start online business and those who want to improve their business. Highlighted is the fact that a business model is not just a document that helps obtaining investment, but it's truly a severe examination of whether modeled business idea is viable. Moreover, it can be used as a key tool for planning and control. Also, it is a sort of a guide for enterprise.

Defining all mentioned segments and analyzing each one of them individually and in correlation in the early stages of development of business can save great deal of time and costs later on. It can indicate the weaknesses of start-up idea and give a chance to correct those weaknesses before making any serious mistakes.

Starting a business involves taking responsibility for decision making, becoming increasingly self-reliant, pioneering, adventurous, daring, dynamic, progressive, proactive, opportunist, ambitious and holding values.

Canvas business model includes all steps required for implementation of business, leading from idea to realization and enabling to focus on key segments. Simultaneously, this model can be used for improvement of existing business. Lean Canvas, on the other hand helps users to focus on problems and product itself, and therefore understand the problem. In uncertain, risky and dynamic conditions, most start-ups forget to be analytical and thus fail to observe all potential risks. In example mentioned in this paper, it is shown how these models can be used to present the most important features of a business, thus, we can conclude that both Canvas business model and Lean Canvas can be of significant importance for enterprise. The main benefit of both of them is to have one single view on what a business model is. That way, misunderstandings among stakeholders and time-consuming discussions on the business model will be excluded.

The business model is crucial for any business since it represents the first tangible manifestation of the organizational phenomenon, because it obliges the potential entrepreneur to get moving.

REFERENCES

Amit, R. and Zott, C. (2001) *Value creation in E-business*, Pennsylvania, USA, University of Pennsylvania

Chhabra, S. (2013) *ICT Influences on Human Development, Interaction, and Collaboration*, Pennsylvania, USA, Information Science Reference

Chesbrough H. (2006) *Open Business Models: How to Thrive in the New Innovation Landscape,* Boston, USA, Harvard Business School Press

Coes B. (2014) *Critically assessing the strengths and limitations of the business model canvas*, The Netherlands, University of Twente

Croll, A. and Yoskovitz, B. (2013) *Lean Analytics: Use Data to Build a Better Startup Faster (Lean Series),* Sebastopol, USA, O'Reilly Media

Daidj N. (2014) *Developing Strategic Business Models and Competitive Advantage in the Digital Sector*, Pennsylvania, USA, Business Science Reference
Dollinger, J. M. (2003) *Entrepreneurship: Strategies and Resources*, Lombard, Illinois, USA , Marsh Publications
George,G., & Bock, A. J. (2011) *The Business Model in Practice and its Implications for Entrepreneurship Research* Entrepreneurship Theory and Practice, 35(1), 83-111.
Lee, I (2009) *Handbook of Research on Telecommunications Planning and Management for Business*, Pennsylvania, USA, Information Science Reference
Neilson, L. G. and Pasternack, A. B. (2005) *Results: Keep What's Good, Fix What's Wrong, and Unlock Great Performance*, New York, USA, Crown Business
Mohapatra, S. (2013) *E-Commerce Strategy: Text and Cases, Springer Science & Business Media*, New York, USA, Springer
Morris, M.,Minet, S., Richardson, J., & Allen, J. (2006). *Is the business model a useful strategic concept? Conceptual,theoretical, and empirical insights*. Journal of Small Business Strategy, 17(1), 27-50.
Osterwalder, A. and Pignegur, Y. (2010) *Business Model Generation*, New York, John Wiley and Sons
Osterwalder A., Pigneur Y, Clark T (2012*) Business Model You: A One-Page Method for Reinventing Your Career,* New York, John Wiley and Sons
Pateli, A.G and Giaglis, G.M. (2003) *A framework for understanding and Analysing e-business models*, Bled, Slovenia, Proceedings of the 16th Bled eCommerce Conference
Radenković, B. Despotović-Zrakić, M. Bogdanović, Z. Barać, D. Labus, A. (2015) *E-business*, Belgrade,Serbia, Faculty of Organizational Sciences
Ries, E. (2011) *The Lean Startup : How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses,* New York, USA, Crown Business
Shafer,S. M.,Smith, H. J., & Linder, J. C. (2005).*The power of business models.* Business Horizons, 48(3), 199-207.
Shiskov B.(2014) *Business Modeling and Software Design,* Switzerland*,* Springer International Publishing
Timmers, P. (1998*). Business Models for Electronic Markets*, Electronic Markets, 8 (2), 3 - 8.

MEASURING DEMAND FOR IT SKILLS ON THE SERBIAN JOB MARKET

Stefan Vujović*[1], Valentina Đorđević[1], Dušan Barać[1]
[1]Department for e-Business, Faculty of Organizational Sciences, University of Belgrade
*Corresponding author, e-mail: stefan@elab.rs

Abstract: *This paper describes how the demand for certain technical skills in Serbia can be measured. The primary goal of this paper is to investigate the current usage of programming languages and technologies in the Serbian industry and to show how the educational institutions can possibly benefit from monitoring the demand for specific skills. This paper will not answer which programming language is the best, but it could help people make strategic decisions such as choosing a programming language to learn or teach and even which programming language to choose in order to build a new and competitive software system.*

Keywords*: IT skills demand, IT job market, programming languages, technologies, platforms, Serbia*

1. INTRODUCTION

It is doubtless that we are witnessing dramatic changes in the field of Information Technology where certain skills become obsolete very fast. It happens very often that one technology that was considered the best solution for one problem in a very short time becomes replaced with other kind of technology.It has become hard to keep track of all the changes and the needs of the job market both for students and educators.

The information about programming language popularity, for example, is one Google search away but it is most often measured on a global level or in the US. However, the demand for technical skills needed in Serbia and in the US for example, are not identical. This is why we decided to monitor the demand on the Serbian market only.

There are various methods of measuring the popularity of programming languages proposed:

- counting the number of times the language name is mentioned in web searches, such as it is done by Google Trends. The main problem here is that the results may be corrupted because when typing Python, it could be an animal, or a programming language; Java could be an island of Indonesia and a programming language, etc.
- counting the number of job advertisements that mention the language, as it is applied in Indeed.com or TrendySkills.com web sites that are offering statistical data and quantitative representation about trends that job employers and employees seek in the IT industry.
- the number of books sold that teach or describe the language. A good example is Nielsen BookScan, which aggregates point-of-sale data from about 70% of US bookstores, including Amazon, Barnes & Noble, Borders, and many smaller chains and leading independent bookstores.
- estimate the number of existing lines of code written in certain language. Most often, it includes searching the web with the language name as a keyword, gathering code data and analyzing them. (Bieman & Murdock, 2001). The main problem could be underestimating languages not often found in public searches.
- counts of language references (i.e., to the name of the language) found using a web search engine. A good example of this practice is TIOBE.com, that is exploring trends based on the TIOBE index. The TIOBE Programming Community index is an indicator of the popularity of programming languages. The index is updated once a month. The calculation comes down to counting hits for the search query, and only certain search engines and programming languages qualify, by the beforehand defined criteria.
- counting the number of projects in certain programming language on platforms like GitHub (where the rank represents languages used in public and private repositories, excluding fork) and Stackoverflow (where developers often share where they work, what they build and who they are, and their data could be accessed and downloaded at any time).

- counting the number of postings in Usenet newsgroups about the language, since Usenet is a repository for messages posted from many users in different locations, similar to discussion forums.

Various sources are using different methods, and it would be a mistake if only one was declared the best. The most common approach is to combine more of them, depending on what we want to find out. If the question is which is the most popular programming language - combining web searches, lines of code, topics and book sales would be the best solution. Job advertisements are a good indicator of which language there is the greatest demand in the job market for. Job adverts and language references could be a good choice for determining which language has the biggest growth rate, etc.
Despite all that being said, it is not only the companies that are dictating trends, but the developers themselves as well. Attracting skilled developers can be difficult. So using programming languages that developers like and lots of developers know can be helpful for companies.

Taking the popularity of social networks into account, it would be a good practice to consider the data gathered from social network as well, and that certainly is the way the research would go in the future. It is a great challenge to combine more methods, it would require more time, the sources would be unstructured and more difficult to analyze, thus the results would be more accurate.

Based on the assumption that the primary interest of an educational institution is to prepare its students to properly meet the demand of the job market we decided to use the method of counting the number of job advertisements that mention specific technical skills. Since our department is focused on educating students in Serbia, our goal was to measure the demand for technical skills on the Serbian job market. Job adverts could be a useful indicator because they give us ad hoc results, representing the technical skills employers need.

We did not limit the research only to programming languages, because in many cases knowledge of a programming language is augmented by knowledge of specific technologies and platforms. This is why, when we say technical skills we mean: knowledge of programming languages (e.g. Java, Python, PHP), platforms (e.g. Android, iOS..), Quality Assurance, Linux administration and Game Development.

2. DATA SET

We started collecting data on December, 14th 2015. and we will continue to do so every day, because we believe the data will be even more useful as the dataset becomes larger. The data is gathered from a popular Serbian website called Startit where new job adverts are appearing every day.

The gathered data is separated to 13 columns. The date when the data was collected is inserted into the first column, other 12 columns are for the number of job adverts that mention the following IT skills respectively: Java, .Net, C, Android, iOS, Quality Assurance, Linux, JavaScript, Ruby, Game Development. We decided to track these particular skills because they are currently among the most demanded skills world wide. (indeed.com)

This is a data frame representation of the data collected on the first day:

date	java	.net	c	android	ios	qa	linux	js	php	python	ruby	game-dev
14/12/2015	79	39	6	33	27	20	12	67	57	17	10	11

Figure 1: Pandas DataFrame representation of the data

The process of data collection is automated with a python script which is hosted on an Amazon Elastic Compute Cloud (EC2) and is scheduled to run every day at 5:00 PM (CET). The script counts the number of job adverts with the following tags: java, .net, c, php, js/javascript, python, ruby, android, ios, game-dev, qa and linux.

3. DATA ANALYSIS

After plotting the data collected over the last 5 months we can see that the most job offers require knowledge of Java. JavaScript and PHP are not far behind, but it is also noticeable that these two programming languages have made significant growth in position openings in the last few months.

.Net, Android and iOS respectively are the three platforms wanted by the employers with iOS showing some decline in the past few weeks.

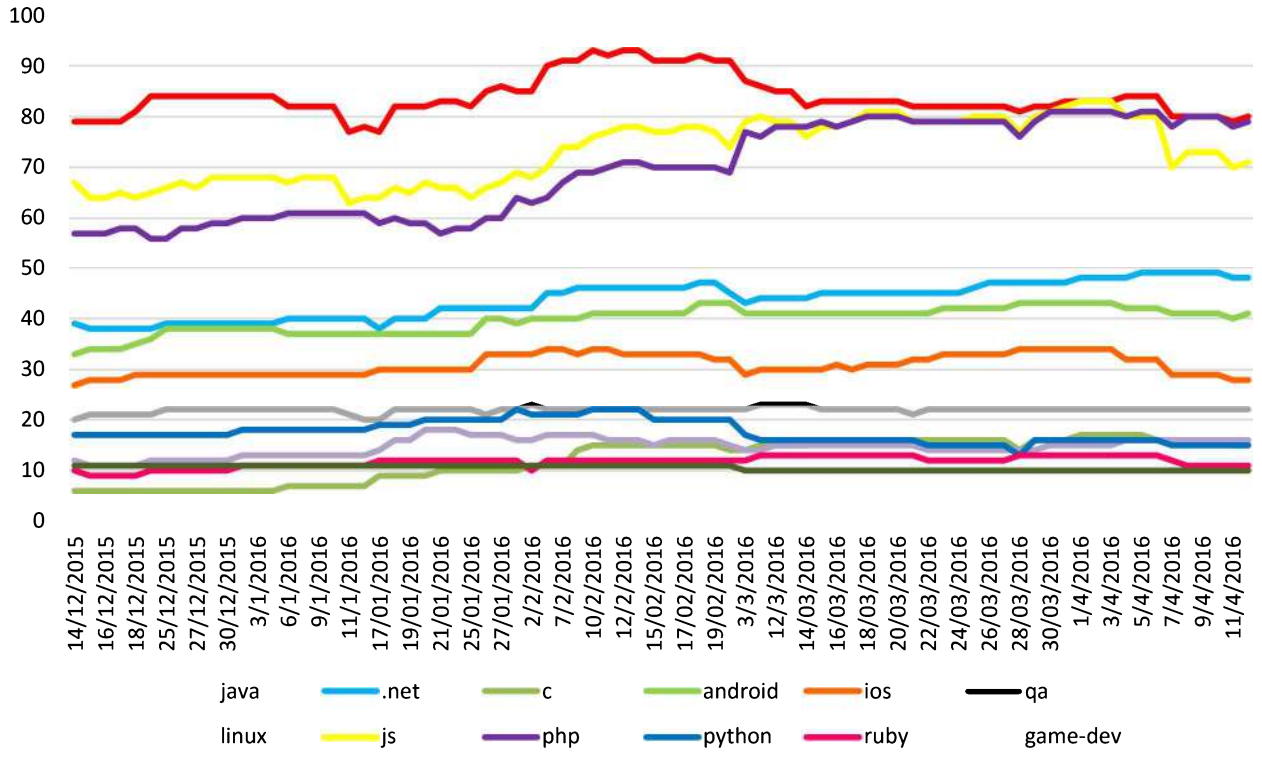


Figure 2: Demand for technical skills through time - Line Chart

When we look at the mean values (number of job posts recorded per day), adverts for Java developers achieved the highest number: 83,88 followed by JavaScript (73,17) and PHP (69.6), .Net (43.7), Android (39.76), iOS (30.97). Than, we have some lower averages, respectively QA - Quality Assurance (21.88), Python (17.56), Linux administration (14.70), C (12.27), Ruby (11.73), Game Development (10.56)

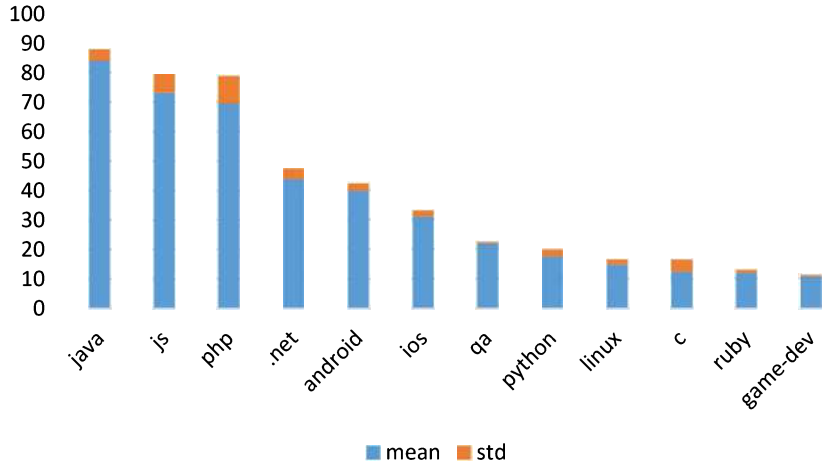


Figure 3: Mean and standard deviation for the number of job adverts for each skill

The largest standard deviation is recorded for PHP (9,32) and JavaScript (6,33) which makes sense because of a significant change in the number of job adverts. The lowest standard deviation was recorded for QA (0,55) which means the number of available jobs that require this skill is near to constant.

When we take a look at the minimal and maximal values we can see that the largest number of positions recorded on one particular date was again Java (93), followed by JavaScript (83), PHP (81), .Net (49), Android (43), iOS (34), QA (23), Python (22), Linux administration (18), C(17), Ruby (13), Game development (11).

The smallest number of available positions recorded was for C (6), Ruby(9), Game Development(10) Linux administration (11), Python (13), QA (20), iOS(27), Android(33), .Net(38), PHP(56), JavaScript(63), Java(77).

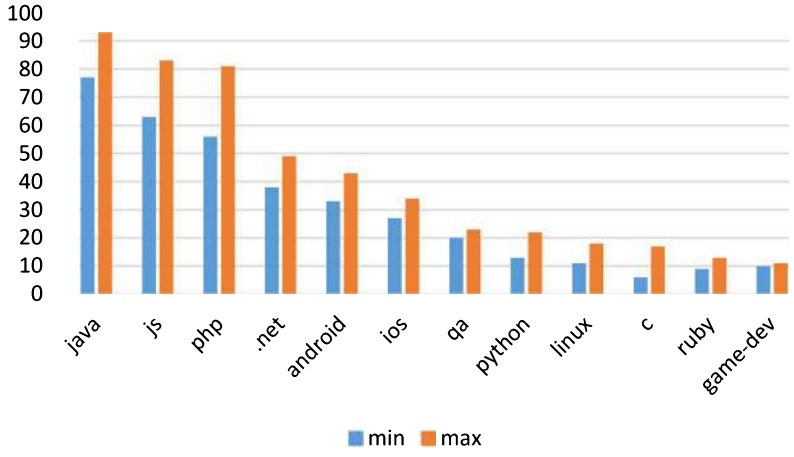


Figure 4: The minimum and maximum recorded value for each skill

On the next chart we visualised the interquartile range (IQR) values for each skill which represents the difference between the upper and the lower quartile. This value gives us the maximum difference between the middle 50% of the data, and in this case it could be interpreted as a metric that describes the amount of change in the number of job adverts that mention the particular skill. This indicates which skills should be monitored, because they have the potential to become more or less popular in the future. In our case, PHP (19), JavaScript (12), C (8,5), .Net (6,75), iOS (4) and Python (4) are the ones for which the demand could possibly grow in the close future. Java (3), Android (3), Linux (2.75), Ruby (2), Game Development(1), QA (0) are the ones with less variability in demand.

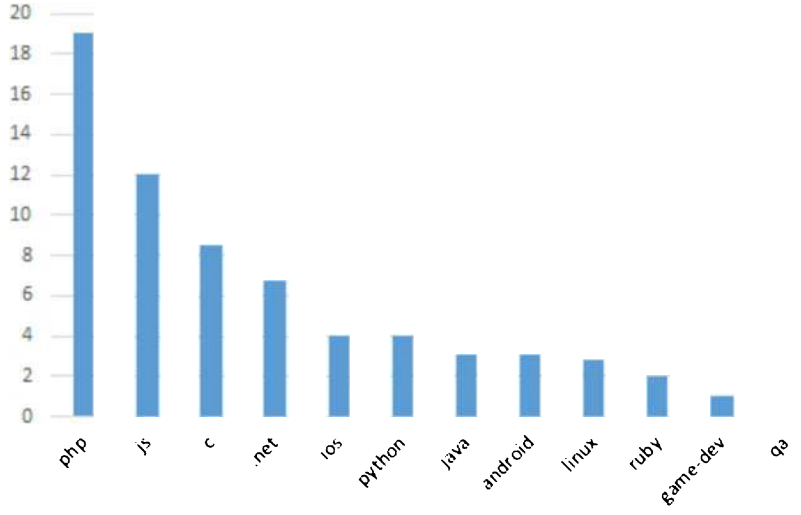


Figure 5: IQR for each of the skills

4. CONCLUSION

It should be noted that the gathered data may not be completely accurate due to the fact that our database was updated every day, but with the current number of job adverts for each skill. This means that if there are 80 jobs that mention Java one day, and 82 the day after, those numbers will be recorded. Therefore we are not aware what is the actual number of unique job adverts for each skill. This is important because of the website's policy which in some cases requires payment for adverts which has an impact on the time a certain advert is active on the page. Consequently, some adverts are counted for a longer period of time. However, the data we have can serve the purpose of measuring the demand for skills through time.

The first conclusion we made is that the job market demand for the majority of skills in question is growing or in worse case is constant. When it comes to particular skills, the most demanded skill for any position today is knowledge of Java, a general purpose programming language mostly used for development of desktop, mobile, web and other kinds of applications (Đurić et al., 2013) The skill for which the demand has made the most growth is PHP which is mostly used for web development (MacIntyre, 2010). A very close growth of demand was recorded for JavaScipt which has also been mostly used for client-side web development in the past, but has infiltrated the server side in the recent years, since the appearance of Node.js (Powers, 2015). All the skills in question can be separated into three groups: High demand, medium demand, low demand. Java, PHP and JavaScript fall into the high demand group., Android, .Net, iOS make the medium demand group and C, Quality Assurance, Python, Ruby, Linux and Game Development can be classified to the low demand group.

We think that from a perspective of Serbian educational institutions in this field at the university level Java, PHP and JavaScript should be a part of the compulsory curriculum. Android, .Net and iOS are worth considering if they are not already a part of the curriculum. But, for discovering the future potential of a skill it would probably be a good decision to compare the demand trends for jobs in Serbia with the demand trends in the US. From a perspective of someone who is willing to learn in order to get a job in the field, the easiest way to employment is to pick Java, PHP, JavaScript, but it could also be more financially awarding to choose a skill where there is a lower supply of workforce. From a perspective of someone making a decision which technologies are needed for the software system depending on the platforms (desktop, web, mobile..) Java and JavaScipt are probably the best option at this moment.

There are several things that we plan to improve in the future. First of all, the data collection process will be altered in order to track the demand changes more accurately by recording every unique job advert. Secondly, the data variety will be expanded in order to track the names of job positions, companies and cities that are mentioned in job posts in order to make even more detailed analysis and in order to grasp new conclusions. Thirdly, the data volume will be expanded, which means the number of technologies, programming languages and other skills will be taken into account because the idea of the system is to identify the appearance and growth of new and currently unknown skills. Additionally, as the dataset grows, we will be able to find out if the growth of demand for one skill impacts the decline of demand for other skills or not. We will also be able to understand which skills when they are combined are most needed by the employers in Serbia. And finally, the data will be collected from several different sources in order to find larger amounts of data and to draw less biased conclusions.

REFERENCES

Beazley, D, & Jones, B. K. (2013). Python CookBook: Third edition. Sebastopol, CA : O'Reilly Media.

Bieman , J. M. , & Murdock, V. (2001). Finding Code on the World Wide Web: A Preliminary Investigation. Presented in Proc. First Int. Workshop on Source Code Analysis and Manipulation (SCAM 2001).

Bulajić, M. & Vuković, N. (2014). Basics of Statistics. Belgrade, SRB: Faculty of Organizational Sciences.

Đurić, D, Jovanović, J., Milikić, N, Tomić, B, & Ševarac, Z. (2013) The programming Principles. Belgrade, SRB: Faculty of Organizational Sciences.

MacIntyre P. (2010). PHP : The good parts: First edition. Sebastopol, CA : O'Reilly Media.

Powers S. (2015). JavaScript Cookbook: Second Edition. Sebastopol, CA : O'Reilly Media.

A small place to discover programming languages on GitHub (2014). Retrieved from http://githut.info/

Indeed.com: Job Search, http://www.indeed.com/ , visited on April 12th, 2016.

Stackoverflow Developer Survey Results 2016 (n.d.).Retrived from http://stackoverflow.com/research/developer-survey-2016#overview.

Tiobe Index. (n.d.) Retrived from http://www.tiobe.com/tiobe_index?page=index .

TRENDS SHAPING BUSINESS MODEL INNOVATION IN TELECOMMUNICATION COMPANIES

Nenad Orlić*[1], Vojkan Vasković[1]
[1] Faculty of organizational sciences, University of Belgrade
*Corresponding author, e-mail: orlic@madnet.rs

Abstract: *Business innovation is constant process for all companies but Telecommunication companies are facing ever bigger pressure to adapt to fast changing market conditions and improve performance and profitability. Changing user habits and increased regulation of telecommunication markets are putting pressure on companies to change their business practices and reinvent themselves not just to improve but to survive. This article gives an overview of current trends that fuel change in business models of telecommunication companies and analyses case for a freemium-like revenue models. It identifies key components of such a model and proposes changes to some standard practices and new sources for revenue.*

Keywords *, business model canvas, Telecommunication, Cloud computing, Internet of Things, freemium*

1. INTRODUCTION

Term 'Business model' is first mentioned in academic article by *Bellman and Clark (1957)* but it begins to be popular subject only at the end of 20th century. Since then, many authors offered their definitions of the term and tried to establish it's elements.

For the needs of this paper, we will accept definition of the term „business model" and it elements as defined by *Osterwalder, A., Pigneur, Y., & Tucci, C. L. (2005),* in their paper that is widely acknowledged. Their definition of the business model is: „A business model is a conceptual tool that contains a set of elements and their relationships and allows expressing the business logic of a specific firm. It is a description of the value a company offers to one or several segments of customers and of the architecture of the firm and its network of partners for creating, marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams." In the same paper they define nine building blocks of business model as its basic elements.

Table 1: Business model Building Block, *Osterwalder, A., Pigneur, Y., & Tucci, C. L. (2005)*

Pillar	**Business Model Building Block**	**Description**
Product	Value proposition	Gives an overall view of a company's bundle of products and services.
Customer Interface	Target customer	Describes the segments of customers a company wants to offer value to.
	Distribution channel	Describes the various means of the company to get in touch with its customers.
	Relationship	Explains the kind of links a company establishes between itself and its different customer segments.
Infrastructure management	Value configuration	Describes the arrangement of activities and resources.
	Core competency	Outlines the competencies necessary to execute the company's business model.
	Partner network	Portrays the network of cooperative agreements with other companies necessary to efficiently offer and commercialize value.
Financial Aspects	Cost structure	Sums up the monetary consequences of the means employed in the business model.
	Revenue model	Describes the way a company makes money through a variety of revenue flows.

Need for change of the way some companies operate their business may come from many places. Outside factors such as changes on the financial markets, technology advancement, user behavior and others are influencing decisions of management to adapt business models on whom their base their operations. Companies rarely change everything about how they operate – they mostly change elements of their business model to best accommodate their inner organization to new challenges on the market.

Telecommunication companies are subjected to many outside factors forcing them to change the way they do their business, mostly because of fast advancement of technology. That advancement has disruptive influence on the telecommunication market. In this paper we will try to identify trends that influence the change in business models of telecommunication companies, tie them to relevant element of business model and show how companies adapted.

2. TRENDS INFLUENCING CHANGES IN TELECOMMUNICATION COMPANIES

It is important to clearly distinguish business model from business process model. First can be viewed as firm's basic rules and guidelines on creating and commercializing value, while latter is the way business implements a certain process in its operations. Optimization of business process model bring efficiency to work process that is being reviewed. Changes in business model are done to expand overall capacity and competitiveness of the company.

In search for a key change in business model that could improve competitiveness of telecommunication companies in developed markets we identified trends that fuel change in segments of business models and then searched for relevant cases that show how companies adapt to new changes on the market.

Table 2: Business model elements and corresponding trends influencing them

Business model element	**Influenced by**
Value proposition	Integration of content offerings
Target customer	Internet-of-Things and increasing need for M2M communication
Distribution channel	Over-the-top content
Customer Relationships	Social networks
Core Competency	Outsourcing
Partner network	Changes in market regulation
Cost structure	Cloud computing
Revenue model	Success of freemium model in software market, especially apps for mobile devices

Integration of content offerings

"Content is King" is the *article Bill Gates wrote (1996).* In it, he claims: "Content is where I expect much of the real money will be made on the Internet, just as it was in broadcasting." This is now truer than ever. Lines between service provider, content provider and classic telecommunication provider are getting blurred with each of them expanding its offer with basic service bundled with different content, own or licensed.

In telecommunication world, customers were first offered 'single-play': separate voice, broadband or television service. 'Double-play' was introduced as integration of voice and broadband in a single package. 'Triple-play' included television as third component of the package and in the end 'quad-play' offer was created by including mobile service. In a world where 'Content is King', telecom operators needed to find a new value proposition for their customers who increasingly found this kind off offers to be inadequate

Apple, currently technology company with biggest valuation, is not just selling hardware it selling platform for content distribution. Their iTunes platform is key to their success. In year 2012, iTunes had 64% of paid music download share in USA according to Statista.com (2012).

Importance of integrated content offering is demonstrated by company Layer 3. They are trying to beat Comcast, largest USA cable company by offering content bundle from different content owners and at the same time integrating content from social networks in a seamless way for unique user experience. Although they are yet to produce visible result in terms of market share, key executives of this company are experienced old-cable-company managers that invested their time and money in something they think is a future of cable.

Internet-of-Things and increasing need for M2M communication

Internet-of-Things (IoT), a network of all sort of thing and appliances that are connected through standard internet infrastructure using standard communication protocols, is growing rapidly and will continue to grow in foreseeable future, as pointed out by *Mazhelis, Warma and others (2013).*

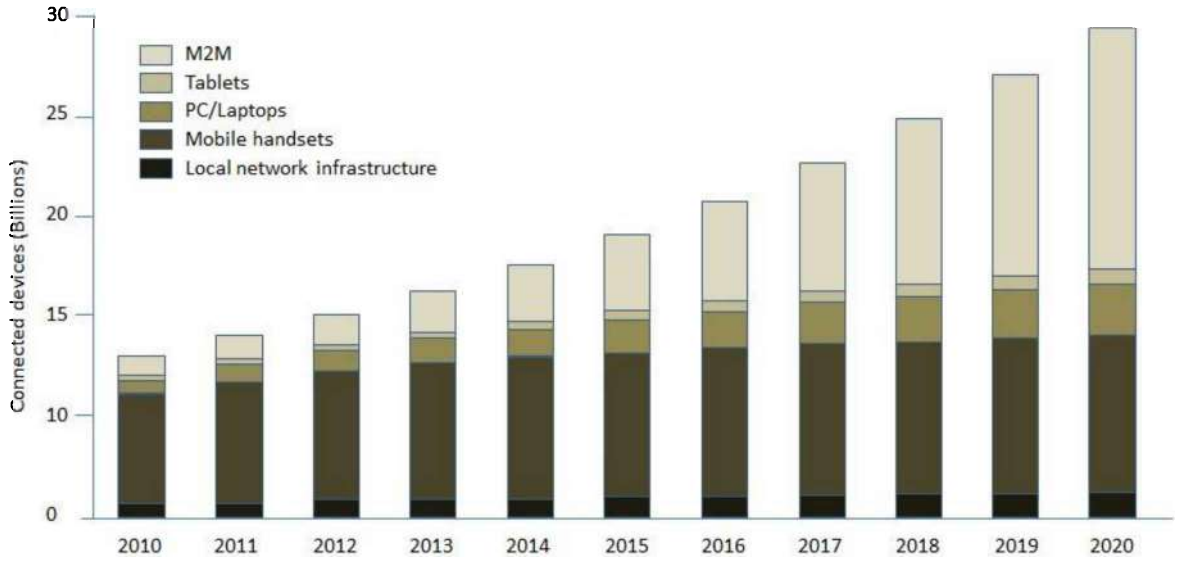


Figure 1: Forecast of growth of connected devices in IoT

It has become increasingly visible thanks to the rise of intelligent devices such as thermostats or refrigerators, smart fitness trackers, and the promise of autonomous vehicles. As Figure 1 shows, predicted growth in number of devices connected is set to grow to 30 billion by 2020, which is nearly three times the number of people on Earth. This growth opens up one complete new market segment for telecommunication companies. Their customers will need to find way to connect all these devices and that is huge opportunity that telecom operators do not want to miss. Telecom operators could exploit this opportunity by developing a flexible platform which will act as an enabler for IoT by providing a 'menu' of services to customers.

Other way to do so is expanding business by entering other sectors by merger or acquisition. The IDC report noted British telecommunication operator Vodafone's acquisition of Cobra Automotive Technologies in 2014 as an example. According to Vodaphone, the acquisition will help them become a global provider of connected car services for automotive and insurance customers. Another example is E2 Hungary, a joint venture utility company founded by MET Holding and Magyar Telekom, which started operating in January 2016. The merging of the two companies' client portfolios has already started with the transfer of Telekom's complete industrial utility business into the new company, which will also supply most of MET's current commercial clients. The 50-50 joint venture utility company will supply natural gas and electricity to more than 4,000 business customers in Hungary. Such a portfolio will put the new company among the most dominant players in the power and gas market. But most importantly it will give it an edge over competition in implementation of smart energy solutions based on IoT concept.

Over-the-top content

An over-the-top (OTT) application is any app or service that provides a product over the Internet and bypasses traditional distribution. Services that come over the top are most typically related to media and communication and are generally, if not always, lower in cost than the traditional method of delivery.

Over-the-top application can be anything that disrupts traditional billing models. Examples include Hulu or Netflix for video (replacing traditional cable TV provider) or Skype (replacing standard telecom operator providing long distance calls).

The creation of OTT applications has led to a wide-ranging conflict between companies that offer similar or overlapping services. The traditional telecom operators have had to anticipate challenges related to third-party firms that offer over-the-top applications. Well known example is conflict between Netflix and Comcast that resulted in Netflix paying Comcast for interconnection to its servers. In effect, OTT services created two-way distribution channel for both digital services providers and telecom operators. Digital service providers use networks of telecom operators as distribution channel for their services but at the same time telecom operators are expanding their digital services to new customers through networks of their competitors.

Social networks

Social networking sites such as Facebook and Twitter have become more than platforms for marketing and advertising. Increasingly, they are also valid and important channels through which customers, both old and new, solicit and receive customer service. According to Nielsen's 2012 Social Media Report, nearly half of U.S. consumers use social media to ask questions, report satisfaction, or to complain. Third of social networks users prefer to make contact over these media then over the phone.

Providing multi-channel support that includes social networks can present real challenges for B2B and B2C companies both large and small as well as opportunities to positively impact sales and customer loyalty. The reality is that customer service expectations are constantly rising and customers are expecting attention that spans from the showroom floor to the Facebook timeline. They require constant communication with companies and prompt answers to their questions. They want companies to be with them 24/7.

Burden put on companies is very high because not only they are required to answer to customer demands instantly through social networks they are required to do so mostly publicly and that demands different set of skills from people in support department then those required for customer support over the phone which was standard not so long ago. This is true for telecommunication companies as it is for any other.

To accommodate to this new demands, changes in internal organizational structure of companies is required. Adaptation of business model, in segment of customer relationship is necessary. Organizations tend to outsource online support, public relations and online marketing to companies that specialize in management of online presence on social network for other companies. As telecom operators provide 24/7 service for their customers, and social networks allow customers to be in constant contact with companies, integration of support, PR and marketing in-house may be necessary to meet this 24/7 level of support over social networks.

This problem is identified by Facebook and other and they are starting to implement AI (artificial intelligence) and bots (automated answering) to try at the same time to make it easier for companies to meet demands of customers and to help users get quality support as fast as they can. In April 2016, Facebook launched automated bot support and provided API for developers to build their own automated support service that will work with Facebook Messenger. At the same time, Microsoft is experimenting with its own AI based support. Xiaoice (Chinese word meaning “Little Ice”) is an advanced natural language chat-bot developed by Microsoft, for Chinese blogging service Weibo. Response of users is overwhelming with 850 thousand followers and average number of user interaction at 60 times a month.

Outsourcing

Outsourcing is allowing Telecommunication companies to focus on core competencies that are different from ones that we can find in more traditional business models, such as technological infrastructure or technological innovation. Outsourcing of services is nothing new and it has been used widely by telecommunication

companies. In a rapidly changing industry ecosystem, heavy investments in hard infrastructure can burden balance sheets and limit growth without outside funding. That is primary reason why we witness change in type of outsourcing where companies are outsourcing what is generally considered as basic core competency for telecom operator.

Leading example of this trend is Bharti AirTel Limited, telecom operator from India and their 'Total outsource' philosophy.

Bharti Airtel Limited is a global telecommunications company with operations in 20 countries across Asia and Africa. The company ranks amongst the top 4 mobile service providers globally in terms of subscribers with 307 million customers across its operations at the end of November 2014. Their core competency is not technology but branding and identifying customer pain points. Telecoms operators are classified as a high technology industry, but Bharti, on the other hand, has little expertise in technology. Their management team made a counterintuitive move: It outsourced network installation, maintenance, and service. Companies like Ericsson and Nokia Siemens Networks are operating core network, and IBM has built and managed its IT systems.

The vendors that were given task of network management are paid only for the capacity utilized by Bharti Airtel, not for the equipment. Bharti's innovative business model converted fixed costs in capital expenditure to a variable cost based on usage of capacity. Through this outsourcing arrangements, Bharti dramatically lowered its costs while ensuring high quality for customers, since vendors had world-class competencies in their domains. This allowed company to focus on marketing and customer acquisition which in turn allowed it to become one of dominant telecommunication operators in Asia.

'Total outsourcing' strategy is not without its downsides. In the last two years, Airtel did see its profit margin decline and decided to lower level of outsourcing and brought control over some of key functions in-house. Their tactics and unusual choice of core competencies allowed them to grow in unpreceded scale and adjustments made are more of evolution of their decade-long business model then deviation from it.

Changes in market regulation

There are many papers covering subject of market regulation influence on investment or service quality (see, for instance *Grajek & Röller, 2012 or Haucap & Klein, 2012*). Trend of increased market regulation for Telecommunication services continues in both USA and EU. New regulations were recently introduced on user privacy, data retention, net neutrality, open access, roaming tariffs. This regulation not only affect how telecommunication companies behave toward customers but also between each other thus directly influencing partnerships between them.

For example, net neutrality rules introduced with FCCs Open Internet order are directly limiting some existing and planned partnerships between companies providing broadband access and those providing digital services. Open Access Rules and Order, comes down to few Bright Line Rules:

- No Blocking: broadband providers may not block access to legal content, applications, services, or non-harmful devices.
- No Throttling: broadband providers may not impair or degrade lawful Internet traffic on the basis of content, applications, services, or non-harmful devices.
- No Paid Prioritization: broadband providers may not favor some lawful Internet traffic over other lawful traffic in exchange for consideration of any kind—in other words, no "fast lanes." This rule also bans ISPs from prioritizing content and services of their affiliates.

Those provisions, especially last one, clearly put some limit on how telecommunication companies in USA can arrange their partnerships with content providers.

In September 2013, the European Commission adopted a legislative package for a "Connected Continent: Building a Telecoms Single Market" with goal of equalizing market regulation in all EU states. In October 2015 the European Parliament's plenary voted in favor to end roaming charges by June 2017. From April 2016, operators are able to charge only a small additional amount to domestic prices up to €0.05 per minute of call made, €0.02 per SMS sent, and €0.05 per MB of data (excl. VAT). From June 2017 they will be forced to

charge same price for domestic and roaming traffic for voice, SMS and data. This regulation directly limits roaming agreements between telecom operators in EU and forces them to completely change this element of their business model and existing relationships with their roaming partners in EU.

General Data Protection Regulation passed in April by European Parliament introduces major reforms on current rules dating from 1995. It will come into force in April 2018 and will have wide reaching impact on how telecommunication companies and providers of digital services can use, handle and transfer user data. Since some telecom operators are trading with user data they will have to stop with that practice and that will have big effect on their relationships with companies from other sectors, especially marketing.

Cloud computing

Cloud computing, term that produced much hype over the last few years is now influencing cost structure of companies in some ways that were hard to predict. Now Cloud computing is now embraced in almost all branches of IT industry and beyond. *Mell and Grance (2011)* identified and classified several types of Cloud computing, but in most of its forms it may be looked upon as outsourcing and is mainly considered as such. There is new situation on the market where telecom operators are at the same time both providing cloud services to others and using other cloud services to provide some of it services to customers. Example for this are OTT IPTV cloud services that more and more operators are offering every day and at the same time more and more operators are providing their IPTV services to the customers based on Cloud platform hosted with the another operator.

There are several big players in the market that managed to provide service for even biggest and most demanding telecommunication companies. One such company is Amazon and its AWS service. Many digital service providers such as Netflix, Airbnb, Pinterest are using its services. Out of telecom companies that use AWS service, Comcast and NTT DOCOMO are probably the biggest.

Comcast is one of the largest providers of video, high-speed Internet, and voice services in USA. When demand for the company's new Xfinity X1 delivery platform exceeded the capacity of its on-premises data centers, they expanded capacity by using AWS. Comcast was able to quickly add capacity with Amazon VPC and Direct Connect, expanding their data centers to meet the scale of new demand.

NTT DOCOMO, Inc. is a leading mobile phone operator in Japan. When the popularity of its voice recognition service caused performance and capacity issues, the mobile operator decided to try AWS as a way to decrease strain on its network. Together with staff from Amazon, DOCOMO created a voice recognition architecture on AWS that helped the company scale for better performance during traffic spikes and accommodate its large and growing customer base.

Those examples show how implementing outsourced Cloud service can help telecommunication companies to quickly expand its capacity without big increase in capital expenditure to cover infrastructure cost.

But such approach has to measured. Those providing cloud services are doing it for profit and there is margin in their price. Companies need to plan volume growth of services they provide based on outsourced Cloud services because cost can increase nonlinearly compared to growth in service usage. Example for this can be found with Dropbox, one of largest provider of Cloud storage for users around the world, and one of most famous former Amazon customer. Dropbox had to move out of the AWS Cloud service to lower its operating costs. Process of moving such large amount of data from Amazon to its own data centers was not easy task. Transferring 500 million customers and 500 petabytes of data took almost three years.

All businesses need to take into account growth projections so in the end they do not lose to operating cost all the savings they managed to make on infrastructure investment. This new in-and-out Cloud strategy, if well managed, can significantly improve how fast and efficiently telecommunication companies can expand their offering to new and existing customers both in terms of new services but also in geographical coverage of their networks.

3. FREEMIUM-BASED REVENUE MODEL

As shown in previous chapter, telecommunication companies successfully adapted segments of their business model to changing market conditions and new trends. Revenue model segment of business model can be decisive factor in success of telecommunication company in competitive market. That is the reason why this subject is treated separately in this paper.

Success of freemium model that has proved itself in mobile apps (Liu, C. Z., Au, Y. A., & Choi, H. S. (2012)) and gaming industry is prompting other industries to experiment with similar models for their own services. Digital service providers such as Zynga (mobile games) and Spotify (music service) have built their entire businesses on the freemium business model. Spotify offers free music streaming to some 20 million customers with some 5 million customers opting to subscribe to Spotify's premium service.

Variations of this revenue model is present with telecommunication companies for quite some time. Operators are luring new customers with free trial offers to get them to sign-up for a service in the hope that customers will be satisfied with the service and decide to pay for it.

For years some telecom operators in USA are offering services in a form that is essentially based on freemium model. In 2013, T-Mobile offered buyers of select Windows 8 laptops free 4G broadband service for two years, but with limit of 200 MB traffic per month and with no strings attached. Once the free monthly data cap was met, trial users could subscribe to one of T-Mobile's premium subscription plans. Although average customer might use up the free monthly allowance of 200 MB in just a couple of hours, with this offer T-Mobile provided glimpse of its 4G service to new customers that otherwise would not event try it, let alone decide to pay for it.

Virgin mobile has experimented with freemium model for its mobile services for years. In 2008 it has introduced option for its prepaid customers in USA to add free minutes to their account when they look at the commercials and fill out surveys on their web portal. Recently, in September 2015, they introduced #Freemium package for users of Virgin mobile in Poland. Free option includes a packet of data of 300 MB, 30 minutes of calls for duration of 30 days, and without any obligation, without a contract. When customer spends this allotment, he can still use the services but according to the price list.

Using business model canvas, developed by *Alex Osterwilder in his publication Business Model Generation (2010)* we will try to present how Business model for telecommunication company with freemium-based revenue model looks like and how it compares with standard Business model for telecommunication company.

There are many examples of different freemium-like models in offerings of telecommunication companies but #Freemium offer by Virgin mobile is so far only true Freemium offer on the market. This may signal bigger change in revenue model of telecoms and soon we may see this model implemented for other services. If we assume that it can be implemented for other services Business model canvas in that case would look like one presented in Figure 2. We can see that revenue stream consists of two income sources: income from premium services and income from direct marketing. For some of services typically offered by telecom operators in triple-play bundle, new direct marketing channels should be developed to increase revenue from direct marketing especially for service like IPTV. Virgin mobile successfully implemented revenue stream from direct marketing for its mobile prepaid users but that model uses direct marketing channels not directly tied to the service itself, but one that uses traditional web-based approach, one that is detached from user's experience when using mobile phone. Therefore, there is room for improvement on that model that would allow direct marketing through basic voice service both mobile and fixed one.

As we can see in Figure 2, other segments of Business model canvas do not differ much from some standard telecommunication company business model. What is noticeable is that customer segments consist only of end-users because freemium-based model is not well suited for business users that require higher level of service that one that be provided in freemium based model.

What cannot be shown through business canvas is possible change in relationship with key partners. All relationships are there as they would be with any standard model for telecommunication company, but that partnership can be based on different principle. It is standard for telecommunication company to sign contracts for content rights or for upstream bandwidth based on fixed price per unit and for a certain volume. But with

freemium model, that partnership could be arranged in a such way to be completely or partially based on revenue-share model. That would add incentive for all companies that are vertically in provisioning of telecommunication services to support new direct marketing channels by including them in their offers to increase overall income.

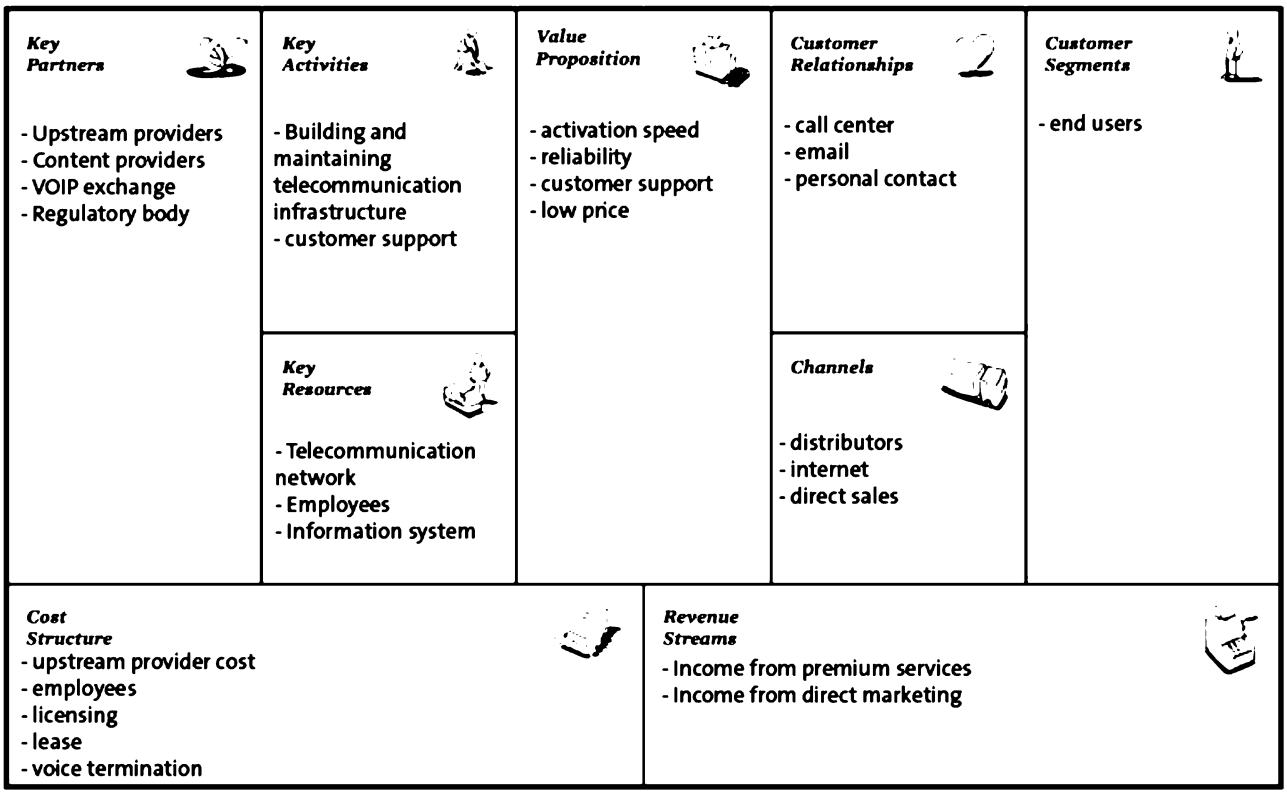


Figure 2: Business canvas model for telecommunication company with revenue model based on freemium-like approach

4. CONCLUSION

We have seen how business models of telecommunication companies are influenced on different levels by different trends. Companies constantly adapt to new surroundings and try to find optimal way to do business and meet customer demand. Every segment of business model is affected by different trends.

To increase competitiveness, telecommunication companies must adapt its revenue streams to include income based on freemium model. Change in other segments of business model is not necessary in that case, but it is recommended to improve its effectiveness. This model was already proven as feasible for mobile operators but there is no reason to think that it could not be implemented for other services offered by telecommunication companies, especially triple-play. Implementation of such a business model would allow companies to compete in saturated market with offer that is different and with very competitive price compared to standard offers.

REFERENCES

Bellman, R., Clark, C. E., Malcolm, D. G., Craft, C. J., & Ricciardi, F. M. (1957). On the construction of a multi-stage, multi-person business game. Operations Research, 5(4), 469-503.

Gates, B. (1996). Content is king. URL: http://www.sick-site-syndrome.com/articles/content-is-king.Shtml (retrieved on 10.04.2016.)

Grajek, M., & Röller, L. H. (2012). Regulation and investment in network industries: Evidence from European telecoms. *Journal of Law and Economics*, *55*(1), 189-216.

GSMA, A. K., & Intelligence, W. (2011). European mobile industry observatory. *Rapport technique, GSM Association*.

Haucap, J., & Klein, G. J. (2012). How regulation affects network and service quality in related markets. *Economics Letters*, *117*(2), 521-524.

Liu, C. Z., Au, Y. A., & Choi, H. S. (2012). An empirical study of the freemium strategy for mobile apps: Evidence from the google play market.

Mazhelis, O., Warma, H., Leminen, S., Ahokangas, P., Pussinen, P., Rajahonka, M., ... & Myllykoski, J. (2013). Internet-of-things market, value networks, and business models: State of the art report. *University of JYVÄSKYLÄ, DEPARTMENT OF COMPUTER SCIENCE AND INFORMATION SYSTEMS, Technical Reports TR-39*, 13-14.

Mell, P., & Grance, T. (2011). The NIST definition of cloud computing.

Osterwalder, A. (2010). Business model generation.

Osterwalder, A., Pigneur, Y., & Tucci, C. L. (2005). Clarifying business models: Origins, present, and future of the concept. *Communications of the association for Information Systems*, *16*(1), 1.

Statista.com (2012), Paid digital music download market in the United States as of September 2012, retrieved from http://www.statista.com/statistics/248995/us-paid-music-download-market-distribution/ on April 2014

RESHAPING THE FUTURE OF BUSINESS PROCESS MANAGEMENT THROUGH SUSTAINABLE CONTENT MANAGEMENT SYSTEM

Dejan S. Milenkovic*[1], Marina Jovanovic Milenkovic[2], Dragoljub Simonovic[2]
[1] Department of Telecommunications and IT (J-6) General Staff, Serbian Armed Forces
[2]Faculty of organisational sciences
*Corresponding author, e-mail: dejan.milenkovic@vs.rs

Abstract: *Starting from the fact that the use of electronic content is an imperative of our age, and the general opinion that the application of modern information technology can establish a solution for a reliable and simple organization and systematization of documentation, the organization's success depends directly on the achieved level of information management. Bearing in mind that timely, accurate, verifiable, readily available and consistent data are the most important for business activities, the basic problem of the use of these data is not their existence, but the place and manner in which these data are stored and organized within distributed business units. Also, the introduction of information technologies in the conduct of business processes, user data is all over, but the question is the degree of their utilization. The subject of this paper is to improve the management of business processes using electronic content management. And goal of paper is to encourage the leaders of those organizations to think in the direction of improving business performance by investing in information technology.*

Keywords*: ICT, electronic content, content (document) management system, business process, business process management*

1. INTRODUCTION

One of the most important factors for successful business process management is the availability and way of information use. Information and knowledge are essential for successful management at all levels of business organization. And having knowledge means reduces the uncertainty in the activities of business organizations, reduces the cost of material resources and engagement of human resources. Also, in the process of implementation of business processes it is require to exchange some information between business units. Depending on the availability and timeliness, information can affect the acceleration or deceleration of activities realization.

Linking business units through information and communication technology enables access to relevant content in electronic form. Also, linking business units enables mutual coordination, integration, delivery, analysis and presentation of information. All of mentioned contributes that business organization makes decisions timely and quality.

There are no quality decisions without quality information. Information and communication technologies are very developed, so problem is not how to get information but problem is how to identify useful information.

The aim of this paper is to point out the problems in the implementation of business processes related to the use of business documents and information contained in. Also, this paper shows basis for the content management in business process management.

2. LITERATURE REVIEW

The necessity of improving performance and adapting to the modern trends of the digital world requires greater application of document management technology. According Adequate planning and setting requirements and conditions for the introduction of advanced information technologies can significantly contribute towards a more efficient implementation of business processes activities at all levels of business management (Goodwin, 2007).

Due to the development of information and communication technology business organizations need to adapt to the market, in order to be competitive and compatible with the continuous goal to became better and more efficiently (Craig, 2008). In whole market in the modern world of information and communication

technologies, information has a crucial role in their final outcomes. It's the same with business organizations where timely information are critical for business success.

Large business organizations require a good and reliable system for storing and organizing documents, and taking into consideration that business documentation is mainly produced in electronic form, managing with electronic documents by using modern information technologies represents a solution for reliable, quick and easy organization and systematization of data. Use of system for managing electronic documentation aims to solve the problem of managing with structural and non structural types of information, their archiving and re-use (Carmel, 2007). Furthermore, managing with electronic documentation contributes to a high degree of communication and interoperability between business organizations at both the regional and global level.

The success in the implementation of set tasks is in direct conjunction with the management of the information contained in the documentation. If the information is in the documents in paper form, and at the same time, the documents are not in one place but are dispersed over distributed units of business organization, processes and procedures in finding information take a long time, and therefore are too expensive. So, managing electronic documents by using modern technological solutions is the solution for reliable, quick and easy organization and systematization of business documents (EMC, 2012).

First of all, for the purpose of understanding the concept of document management, it is necessary to define the document as a basic entity concept and elements that define it. One of the generally accepted definitions of an electronic document is a form of information that is stored on the computer, but it can be treated as singular information within the database (Milenković, 2015). Unlike databases that are structured and have a precise form and content, the documents are carriers of unstructured data. They are intended for storage and transmission of information that have an arbitrary shape and content, as well as for the communication of organization with the environment.

From the viewpoint of business organizations, a document is a permanent record of a business event or a description of the state of the process at a given time. Examples of such documents are organizational rules and guidelines of the business organization itself, documents from the outer environment that affect business organization and influence its business processes and documents arising from the business processes, intended for business processes within the organization or entities from the external environment.

Electronic documents may contain additional information (Metadata) which is primarily intended for describing the document's contents and its characteristics (Milenković, 2015). The content of such metadata is arbitrary, depending on the needs of users and the complexity of business processes that are automated through information system, and often they have information about the author, creation date, and modification of documents, of customer and access time, actions that were undertaken on the document, and of business processes, which the document belongs to. Document management is actually an establishment of rules and procedures for handling documents in all phase of their life cycle: development, verification, approval, publishing, distribution, archiving and reuse. Well-defined and well-organized metadata have an incalculable importance for document management in each of the phase in its life cycle.

So, there are numerous problems in dealing with documents in business organizations. Documentation is created in electronic form, but is subsequently printed and exchanged in paper form manually, which considerably slows down the exchange of information contained in the documentation and increases costs. Flow of document procedure from making documents, signing, distribution and implementation of the same is fixed, and there is the possibility of losing them. This contributes to irrational spending of time and human resources in finding the necessary documents, aggravated execution of the tasks and inefficient decision-making in business (Power, 2009, Turban and Aronson, 2001). Finally, the procedure of document archiving and re-access to the same is difficult and requires time and human resources, and the control of access to documents, particularly of confidential documents, is outdated and inefficient.

3. RELATES BETWEEN BUSINESS PROCESS MANAGEMENT AND ELECTRONIC CONTENT MANAGEMENT

The development of information systems and information technology in general allows reducing the documentation generated in paper form, however, the automation of business processes must not ignore the huge amounts of documents from the past, which exists in paper form. It is necessary to digitize documentation in order to allow the existing business documents in paper form to be used in automated business processes. In this way, the future use of paper documents will be reduced to the minimum or will completely disappear (Milenković, 2014).

In organizations whose business functions are branched out and act on multiple distributed locations, effective monitoring and management processes, in accordance with business requirements and standards, is still one of the biggest organizational challenges. Management systems of (electronic) documentation (Electronic Document Management Systems – EDMS), represent the category of specialized information systems for managing documents and their metadata at all stages of their life cycle exclusively in an electronic environment. EDMS provide a systematic solution for entry, organization, management and storage facilities within the business environment. With their use, unstructured information contained in the documentation are managed according to predefined business rules and procedures. With adequate management of documents metadata through EDMS, it is possible to use the same information contained in the documents in a variety of business contexts, which is a common business necessity.

The following results are achieved by establishing the EDMS in a business organization (Milenković, 2015):

- more efficient realization of tasks and successful achieving of business objectives;
- interoperability in communications in the enterprise market is raised to a higher level;
- task planning and reporting on their implementation is better, more economical and more efficient;
- automation of document management of business and workflow shortens the time for their realization, and makes impact on effective business decisions;
- information contained in the documentation are available in almost real time;
- relevant documentation can be accessed from remote (distributed) location;
- increases the efficiency of human resources, reducing personnel costs;
- reduces the spending of time and material resources (space requirements for the archive, fax machines, paper, copiers, maintenance of office operations);
- achieves centralized automatic storage, and management of documents, and prevents the multiplication of documents;
- provides a high level of access control and security of electronic content;
- standardizes document formats; and
- rises the level of the culture of information management within the organization.

The realization of an EDMS in a business organization aims to modernize the business processes through the introduction of electronic office management. Simply put, the realization of an EDMS in a business organization aims to modernize the electronic commerce through the introduction of electronic office management. In the business to business (B2B) and government to government (G2G) e-business models that stands for the exchange of electronic documents between distributed business units with the primary objective to reduce the use of paper documents to a minimum. In the forms of business to customers (B2C), government to business (G2B) and government to customers (G2C) e-business models, the electronic office management stands for the exchange of electronic documents electronically with users outside the organizational structure of business organizations in order to achieve mutual interoperability, standardization of forms and the content of the documents, and the use of paper documents becomes minimized.

According Pelz-Sharpe (Pelz-Sharpe et al, 2010), Content Management Systems (CMS) are often used as a synonym for terms such as Electronic Document Management System (EDMS). In the context of this study, a content management system represents the most sophisticated element management processes electronic data essential to decision-making processes. CMS can be defined as a set of strategies, methods and techniques used for creating, storing, processing and distribution of electronic contents and documents that are part of the life cycle of organizational processes.

The results of the introduction of electronic content management system are to increase the availability and easier to control content, control access to information, more efficient implementation of business processes, saving material and human resources, reduce operating costs, and certainly support the decision.

Managing with the original copies of the documents is very important, but it is essential to ensure the security of electronic copies (backup /recovery system) and electronic archive of documents, including transaction log file. This document management functionality is extremely important in all forms of electronic business because documentation on activities implemented in business processes often must be available for dozens of years after their creation.

In accordance with their needs, every business organization should define the functional requirements that will be implemented within the electronic content (document) management system. There are other ways to define requirements for information system. In situations where the user does not have the necessary knowledge about the possibilities of information technology, the user engages associate to perform an analysis of the processes that should be automated.

In order to make any decision in relation to improving the content management use it is necessary to analyze the real situation of document management in the organization (Klein & Methlie, 2009). It means that it is required to analyze the types of documentation, or the content which the organization has within its business processes, and then estimate where and how this content is stored and whether and how are controlled.

4. USAGE ICT FOR THE CONTENT MANAGEMENT IN BUSINESS PROCESS MANAGEMENT

The main reason for the establishment of ICT is enabling storage and sharing of data contained in electronic form. Forming the virtual organizations that make asynchronous, distributed and collaborative work teams, which cooperate in the development of projects (collaboration), in different places (distribution) and at different times (asynchrony). As the Katuu points out (Katuu, 2013), ICT contributed to the work of many organizations become more efficient and more successful.

The introduction of ICT leads to changes in the processes of governance and decision-making. ICT enables managers to easily and efficiently perform their functions. Changes in management reduce costs horizontal communication, enabling teamwork and flexibility. Monitoring changes in the environment is critical, which means observing the real environment, competition and financial condition of which depend on business processes and technology trends (Klein & Methlie, 2009).

The importance of ICT for the business system is the common use of decision support software, unified information access, enabling electronic communication and data exchange, data management, increase productivity and reduce costs in business systems.

The development of ICT has enabled faster and better communication, improve business processes, secure storage of information, and easy search of information from any location in the world, 24 hours a day. Thanks to ICT, quality computer connectivity organizational units is achieved through the capacity, speed and efficiency of data collection, processing, transmission and data protection. Computer networking of organizational units contributes fallowing (Milenković, 2013):

- the use of common data and a unique understanding and knowledge of the real situation;
- increasing efficiency and cutting the time required for decision-making; and
- increasing the overall efficiency of the organization as a whole.

Some of the essential elements of ICT on which the realization of a CMS depends are (Cameron, 2011):

- storage (a repository) in which content is stored;
- use of electronic services which guarantees the authenticity of the content and authenticity of the authors of electronic files (documents) (such as electronic signature and time stamp); and
- hardware-telecommunication infrastructure that provides reliable and cost-effective use of all computer resources.

As the requirements for future EDMS are defined above, it is equally important to define the requirements for establishing an appropriate data warehouse that will serve as the repository of content and related data (metadata, data on realized transactions, users, on recorded events, and other data that are the result of the business process).

The repository of CMS is a central warehouse of electronic documents of a business organization and all part of the data that relate to documents and their management. Depending on the structure of businesses and the number and degree of distribution of its business units, the appropriate models of architecture of the repository of content are projected (Matthew, 2003). The designed architecture of the repository should be harmonized with the software solution for EDMS (Milenkovic, 2015).

The application of electronic signature opens up new electronic horizons for an even better and more reliable performance of business processes based on electronic documents (Milenkovic, 2015). Electronic signature is a technology whose application in the exchange of electronically signed documents allows inspection of the authenticity of the signer (authentication), protecting the integrity of the electronic message or document that has been signed (integrity), and non-repudiation of the electronic signature of the person who signed the document or message (non-repudiation). Authentication involves checking and confirming the identity of participants in the exchange of electronically signed documents. This element of protection prevents the possibility of impersonation by malicious users. The application of electronic signature to an electronic document does not provide secrecy (confidentiality) of its contents.

The system of electronic document management should be integrated with an electronic service for issuing and managing time stamps (time stamp authority). Time stamp authority is used to create legitimate

evidence that the business transactions are carried out at a certain time that the electronic document existed at that time and has not been edited at a later date. When using the services of the issuer of the time stamps, the prior establishment of trust with the issuer of digital certificates for electronic signature is necessary. Time stamp in combination with electronic signature and corresponding user applications represent a necessary and a sufficient condition to move from paper to electronic business in accordance with the applicable legal frameworks. The most important use of the time-stamping is in the field of archiving electronic documents, as it guarantees the authenticity of electronic documents regardless of the status of the digital certificate of the signer.

The concept of cloud computing is the business model and technology platform that was created as a result of the evolution and convergence of many seemingly independent computing trends that have been created over the last decade, including computing as a service (utility computing) services on demand (on-demand services), network computing (grid computing) and software as a service (Software-as-a-service) (Vujin, 2011). Cloud computing is an infrastructure that can provide great opportunities for the establishment and use of the system for managing electronic documents for the possible use of computing resources as a service. One of the most important features of cloud computing is scalability, and a key technology that enables that is virtualization.

5. CONCLUSION

Management staff has less and less time to makes decisions about the activities of their business processes, because it is burdened with a large amount of data that needs to be processed and distributed. Preference is given to the business organization that decisions about their activities made on basis of timely, reliable, accurate, verifiable, consistent and easily accessible data. The success of modern business organizations largely shapes the way the information are being used. Information is an important factor in business process management. In the realization of business processes, there is a need to share information among business units. It manifests itself as knowledge and the need for effective management at all business levels, which reduces uncertainty in the business activities; it allow to saves material resources and rational use of personnel capacity.

The establishment of two complex systems within a business organization: the management of business content (CMS) and business process management (BPM), effectively solve the problems in the performance of business procedures. As expected, the two systems must be correlated with one another and only the synergy of CMS and BPM can contribute to a successful business organization. In this way, the organization's business becomes more transparent and more efficient.

Supported by modern information technologies, content management is prerequisite for efficient management processes in business organization and contributes to the creation of competitive advantage and increase in profits.

REFERENCES

Cameron S.A., (2011), Enterprise content management: a business and technical guide. BCS, The Chartered Institute.

Carmel D., (2007), The On-demand Document Management Advantage. Spring CM.

Clair, C.L., Teubner, C. (2007) The Forrester wave. u: Business process management for document processes, Forrester

Craig R., (2008), Document-Centric Process Automation – Meeting The Challenge: Making Documents And Processes Work Together. Spring CM.

EMC, (2011), Documentum content server – Distributed Configuration Guide, available at http://developer.emc.com/developer/documentation.html

EMC, (2012), Enterprise Content Management Input Management Services, available at www.emc.com

Goodwin M., (2006), The Enterprise Document Management Maturity Model. Mclaren software, available at http://docplayer.net/5810868-The-enterprise-document-management-maturity-model.html

Gartner Inc., (2012), Magic Quadrant for Enterprise Content Management, available at www.gartner.com

ISO IEC 82045-1, (2001), Document Management – Part 1: Principles and Methods. International Organization for Standardization.

Katuu S., (2013), The Utility of Maturity Models – The ECM Maturity Model within a South African context. In Capability assessment and improvement workshop (CAIW) at IPRES.

Klein M., & Methlie L.B., (1995). Knowledge-based decision support systems with applications in business: a decision support approach. New York: John Wiley & Sons.

Matthew L., (2003), Mission-critical Network Planning. Artech House Inc., London.

Milenković D., (2013), Statističko upravljanje repozitorijumima elektronskih dokumenata primenom koeficijenata preferencije. Doktorska-disertacija. Fakultet organizacionih nauka, Beograd.
Milenković D., (2014), Razmena elektronski potpisanih dokumenata u Ministarstvu odbrane i Vojsci Srbije. Konf-zbor. U: Simpozijum o operacionim istraživanjima SYM-OP-IS.
Milenković D., (2015), Primena modela zrelosti za utvrđivanje stanja upravljanja korporativnim sadržajem. Konf-zbor. U: Konferencija o računarskim naukama i informacionim tehnologijama YUINFO, Kopaonik.
Milenković D., (2015), Upravljanje dokumentacijom u poslovnim organizacijama. Zadužbina Andrejević. Monografija.
Nelson, R. (2008) On-demand content through interactive content management. Frost & Sullivan.
Pelz-Sharpe A., & et al., (2010), ECM3 - ECM Maturity Model. available at https://ecmmaturity.files.wordpress.com/2009/02/ec3m-v01_0.pdf
Power J. D., (2009), Decision Support Basics, E-book ISBN: 978-1-60649-083-9.
Turban E., Aronson E. J., (2001), Decision Support Systems and Intelligent Systems, 6th edition, Prentice Hall, Upper Saddle River, NJ.
Vujin V., (2011), Cloud Computing in Science and Higher Education, Management, Vol. 59.

STAKEHOLDER RELATIONSHIP MANAGEMENT IN E-BUSINESS OF LARGE ENTERPRISES

Suzana Milinović [1], Dragana Vasiljević[2], Marijana Despotović-Zrakić[2]*
[1]Falc East, Serbia
[2]Faculty of organizational sciences
*Corresponding author, e-mail: maja@elab.rs

Abstract: *The problem researched in this paper is stakeholder relationship management in e-business of large enterprises. The goal is to improve relations with stakeholders by means of modern e-business technologies. The research context is a footwear company whose supply chain is very complex. It needs to monitor the flow of materials from suppliers from different parts of the world, as well as the current production that takes place in multiple locations and countries. The company also coordinates the flow of finished products and organizes delivery for customers located throughout the world. Timely and accurate information and good collaboration among all stakeholders is essential to a successful supply chain. Large distributed companies need well-managed relationships with all stakeholders in order to establish long-term and effective competitiveness of the company's e-business.*

Keywords*: stakeholder relationship management, e-business, large enterprises, e-supply chain*

1. INTRODUCTION

Industrial production of footwear is permanently confronted with problems related to competition in the market. Market requires constant changes: footwear models need to be changed from season to season, new marketing activities need to be realized, and efficiency of the company has to be improved. Therefore typical sets of the goals need to be met:

- Reduce the time of delivery
- Improve the quality of footwear
- Reduce costs
- Accelerate and better direct the flow of movement of raw materials
- Increase the flexibility and time to meet the consumer
- Increase profits

In order for a company to achieve its strategic objectives, it is necessary to review and analyze different interests that stakeholders have, which includes:

- Identification of key internal and external stakeholders
- Analysis of the interests and expectations of the key stakeholders
- Creating management strategies with key stakeholders
- Identifying problems and solving them
- Feedback and control of problem solving.

All this is even more complex when it comes to large enterprises, whose business is spread worldwide. The goal of this paper is to analyze the problem of stakeholder relationship management in e-business of large companies. The specific goal is to present a model for the improvement of these relations which is based on the use of modern e-business technologies. The model is created on an example of a large distributed footwear company.

2. E-BUSINESS OF LARGE ENTERPRISES

Nowadays, it is unthinkable for large enterprises to operate without e-business. Thanks to e-business technologies it is possible to send large amounts of information in a very short period of time. Using different e-business services, large enterprises can significantly reduce costs, increase efficiency and competitiveness in the market, expand business opportunities, speed up work processes, enhance internal and external communication, etc.

Considering the complexity of supply chains of large enterprises, numerous stakeholders can be identified, and e-business technologies can offer tremendous help by providing fast communication and infrastructure

for quick problem solving (Schenkeln et al., 2015). Reduced creativity and reduced entrepreneurial ability frequently occur due to problems of mismanagement in large enterprises. However, it is of high importance to efficiently find creative solutions that can satisfy all the participants in the e-business processes. These solutions often involve compromise, and joint efforts to achieve the goal (Risso, 2010). The structure of relations among stakeholders is crucial to the success of large companies, and this means that each characteristic of a relation need to be considered, including (Bureau veritas, 2016), (Franzoni, 2005) (Il Manuale dello Stakeholder Engagement , 2005):

- Flexibility
- Information exchange
- Synchronization between partners
- Control of the activities
- Equal efforts to achieve the target
- Economic structure relationships.

The exchange of information is very important both within the company and with external partners in order to improve e-business processes and increase the profit of all participants. It is very important that the information is accurate and timely (Aydin et al. 2014).

Efficiency of e-business in the footwear industry improves the production process, technological processes, product development and introduction of new materials. Also, it improves hiring process, the opening of new production facilities and expanding business in general (Mazzola et al., 2015). When a manager uses the obtained information well, they can react promptly and create significant cost savings, and improve the business as a whole. Timely information can affect the sales, reduce marketing costs, influence retention and customer loyalty and attract new customers (Reijonen et al., 2015).

Falc company is a company in Italy engaged in the production of footwear. Falc exists for more than forty years, and each year it became more advanced and expanded. Today the company does all the work related to footwear, from design of footwear models, the development of new products, making knives, soles and insoles, sewing and assembly of finished product. Falc company operates in Ruma and Knjaževac in Serbia under the name Falc East, as well as in Italy and China, and has suppliers from Serbia, Italy, Romania and China. Distribution chain is spread across over fifty countries worldwide. So, it is very difficult to identify and coordinate all the stakeholders, examine their objectives, as they may be different and subject to different legal standards. In large companies it is difficult and complicated to coordinate the supply chain, but it is necessary to make the company perform well.

In Falc East, all business processes are conducted via the Internet. Two main software solutions are used. One is hosted in Italy and to the AS400, which is a complex solution that contains all orders for all manufacturing facilities; complete accounting of the headquarters in Italy, but it does not contain details of the production. The second software solution is adapted to the production and contains all the details of all wholesale customers, the production and materials (Milinovic et al., 2014). Wholesalers through authorized agents make an order, which is through the Internet forwarded to Planning department in Italy. All orders are fed into the AS400 database in Italy, which is then synchronized with the software of the local Serbian Planning department. Then, Purchase department orders the necessary materials from suppliers, it orders the knives, insoles and soles for the products. Then, Planning department creates a plan and program for production using data on expected arrivals of ordered goods. Commercial department provides information to customers on the date of delivery. Software in Serbia is adapted to the production process that takes place in Serbia and is used for data analysis, analysis of stocks, monitoring the production process and other local processes. Also this software can be accessed by management from Italy, so that the production process can be monitored. However, this causes a problem in communication between the various departments. The problem is that departments are not connected adequately, departments in Italy are not fully aware of local problems in Serbia, they are note familiar with timeline of work. For example, if a supplier has a problem with a type of ordered material, this information is not distributed through the supply chain. This could cause deadlocks in production of a certain model, causing delays in production of other models which could have been produced if the information about the first delay had been available on time. Therefore, communication through the chain needs to be enhanced, and adequate means for instant spread of important data need to be researched and implemented.

The analysis of the business process of Falc East helps in identifying the company's stakeholders:

- Suppliers
- Sales Agents
- Customers
- Association for Consumer Protection
- Municipal administration

- Workers
- Dealers in retail stores
- Human Resources Manager
- Technical Directors
- The directors of factories
- Heads of department
- Managing Director
- Technical feature for quality control
- Owners
- Top Management in Italy
- Banks
- Competition

3. MODEL OF STAKEHOLDER RELATIONSHIP MANAGEMENT IN E-BUSINESS OF A LARGE FOOTWEAR COMPANY

Figure 1 shows a model stake holder relationship management for company Falc East. The figure shows stakeholders, as well as services that the company Falc East can use to improve relationships with stakeholders. This model provides a number of e-business services and infrastructure that the company can use to enhance relationships, make successful future projects, improve collaboration and successfully implement strategic plans into action. It also presents services of the company Falc East such as production, marketing, service complaints, sales services and other services that promote, enhance and modernize operations of the company and its stakeholders.

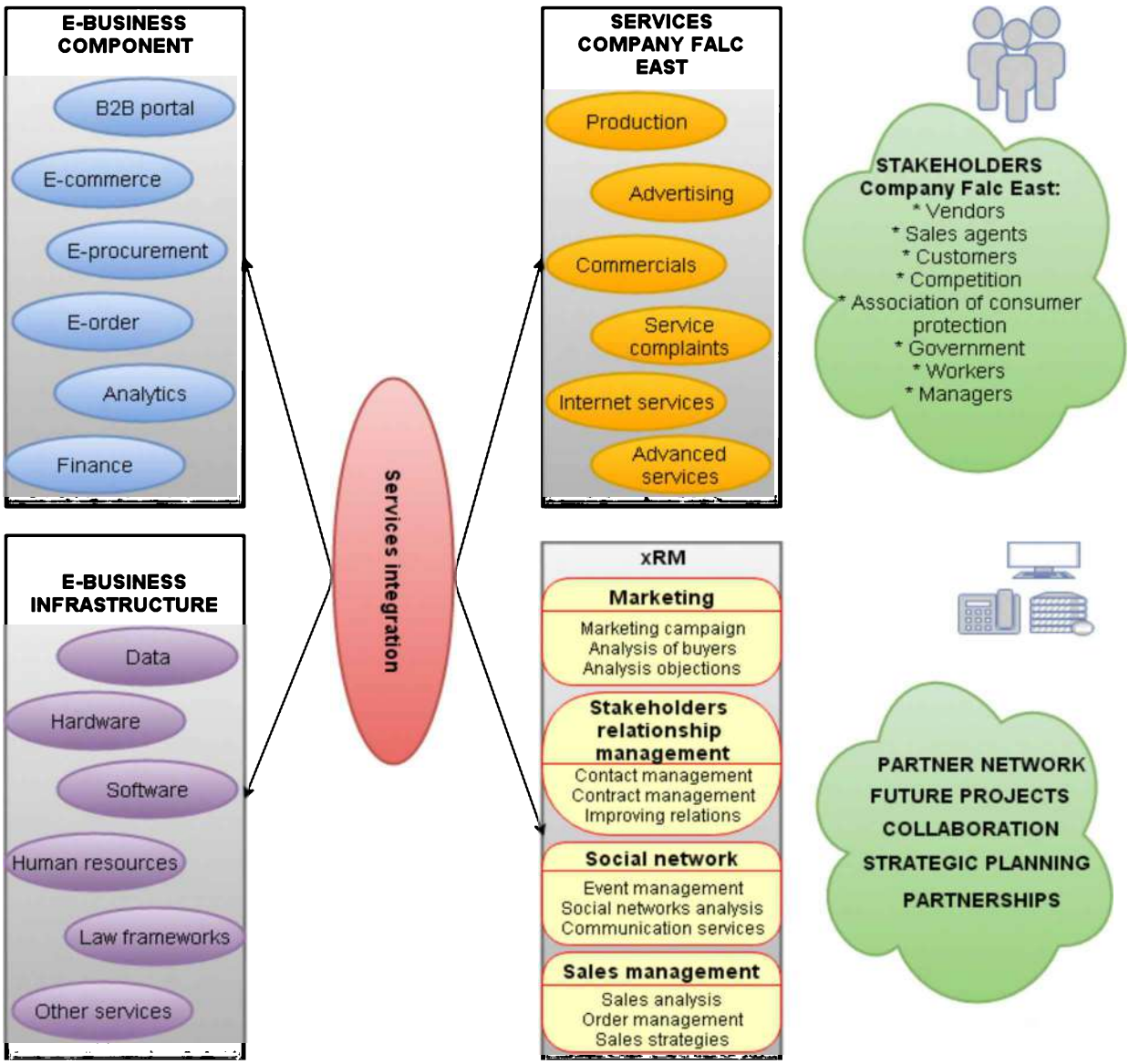


Figure 1. Relationships of Falc East with business partners

3.1 Relationship management with internal stakeholders

Internal stakeholders include management, workers and executives. Figure 2 shows the internal stakeholders in the company Falc East.

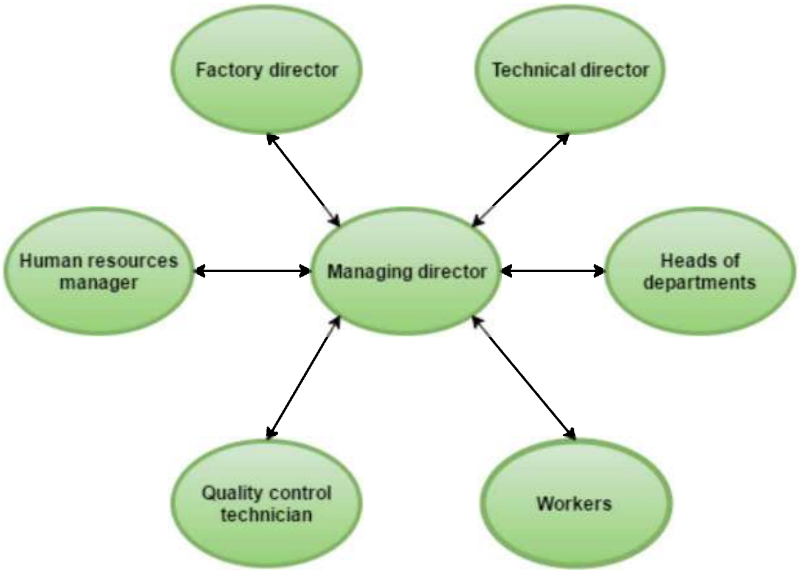


Figure 2. Internal stakeholders in the company Falc East

The analysis of the current situation in the company has showed that the one-way system of communication between the owner, management, managers and workers was used. Internal communication is completely neglected. It is essential that the management creates the environment where employees can express their views, concerns and ideas to improve the company's operations. Solving internal communication problems increases the efficiency of the company, and this is naturally reflected in the final products and therefore to the satisfaction of end users. The introduction of the internal social network would improve the communication between workers and management. It would also improve communication between management in Serbia and management in Italy. Workers would have an opportunity to report a problem or give an idea to make the job easier or more effective, while management would be able to answer and adopt every idea. Using the internet social network all interested parties can share news, comments, and problems and help the development of the company. It is also adequate tool for online team building, because it provides an environment for less formal communication, and therefore a sense of belonging to the company. It could also improve relationships between employees, develop team spirit, improve communication between employees, increase motivation, help in understanding the importance and the impact of each employee, and thus increase the efficiency and productivity.

Mobile services can also improve the internal communication. Company can accelerate the resolution of all small problems in the production, so it is now possible to send messages or images of problems in real time, and it is also possible to get a response. Since the modelers are based in Italy mobile services significantly accelerate troubleshooting in production and thus delays in the production can be avoided. Also, all employees now have constant access to web pages, internet social networks, and other intranet services.

3.2 Relationship management with external stakeholders

External stakeholders are:

- Suppliers
- Sales Agents
- Potential buyers
- Owners
- Top management
- Competition
- Association of Consumer Protection
- Banks
- Municipal administration

Figure 2 shows the external stakeholders in the company.

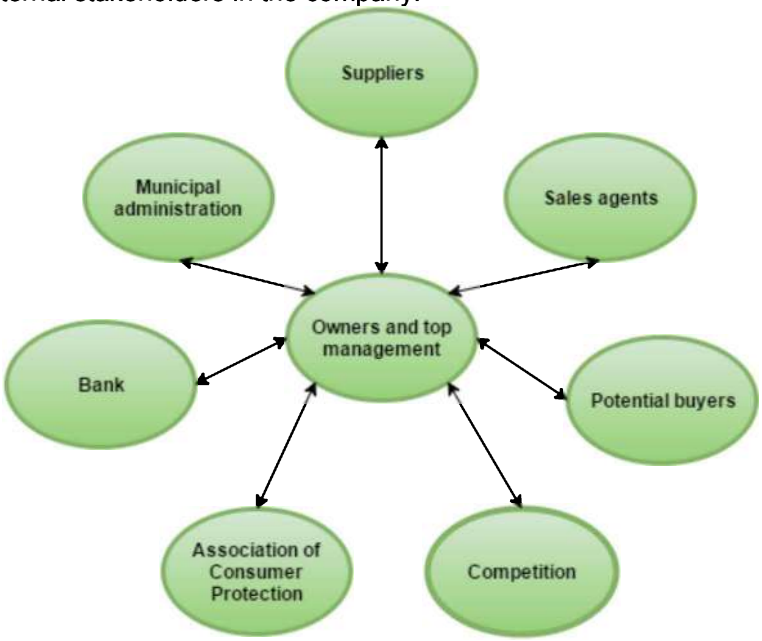


Figure 2. The external stakeholders in the company Falc East

Managing relationships with external stakeholders has multiple purposes, such as:

- The development of future projects such as the opening of new facilities or expansion of existing plant
- Planning to expand markets in Serbia or the opening of new sales outlets
- Strategic planning

Managing relationships with external stakeholders aims to:

- Improving relationships with stakeholders
- Making decisions based on the actual communication with stakeholders
- Prevention of possible future conflicts
- Better business results
- Easier implementation of plans
- Consumer satisfaction
- Reducing the risk
- Increasing Profits
- Increase of sales
- Increase product quality
- Improving the resolution of complaints.

In order to improve operations and reduce costs Falc East company introduced an online business at all levels of operations and with all associates. The first step is to adapt the software to the vendors, create possibilities of electronic invoicing instead of entering all data manually. The quantity of paper documentation should be reduced; the same format of documentation should be applied, leading to higher interoperability of business processes (Chituc et al. 2008). For this purpose ebXML can be used, as well as other specification. Also, higher usage of e-mail or IP telephony should reduce significantly the phone bills, since the orders are made in Serbia and the majority of suppliers are located in Italy and China. Instant messaging can be used for submitting and resolving complaints from suppliers, without misunderstandings and conflicts.

Sales agents should gain access to the central software themselves, so they can make orders remotely, canceled them online if necessary, which would reduce the costs and possibility of errors. Software should analyze all the data in real time, so all employees can update their information on time.

By creating a web site potential customers could buy products online at no additional costs. E-commerce is already a well known concept and Falc is not using the potentials of e-commerce at all. Online sales would improve the sales worldwide, but the distribution network should be carefully organized.

By connecting with consumers through social networks, Falc's management could respond and adopt suggestions and change something in business or in products. Crowdsourcing can be used for gathering design ideas, and online tools could be provided to users so that they could design their own personalized shoes.

Instead of the current flow of information that comes from various parts of the world to the headquarters in Italy, and from Italy to factories in Serbia and other countries, and then returns to Italy so it can be forwarded a particular country, a communication channel which would directly connect the participant in the supply chain should be provided. Direct communication through email, instant messaging and other tools would enable to immediately receive information and get a response. Through social media, management in Serbia would be able to see real time data on all the changes, guidelines for the development of models and the deficiencies that are found on models. Considering that it is necessary to do pre-production pilot test of each model, a pair is sent to Italy. Waiting for the answer takes too much time; this should be improved or changed, since this part of the work can be done very quickly. Pilot trials could be done in Serbia, with online participation of supervisors from Italy or other countries. Supervisor can immediately tell remarks, deficiencies can be corrected quickly and production of that model could start in short time. Also, in the case of certain problems in production of certain models, pictures or video of problems and solutions could be exchanged by e-mail, Viber, web portal or other online tool.

Mobile business can significantly improve operations of large companies. Numerous companies have already recognized the potentials of mobile business and adopted it fully. Falc has a lot to gain through the implementation of mobile technologies. All communication channels could be integrated and delivered via mobile devices, leading to increased efficiency, and increased profit of the company.

4. CONCLUSION

In order to operate successfully, a company needs to manage the relations with all the stakeholders. Understanding the organization, employees, the needs and expectations of all stakeholders, as well as successful and effective communication are essential for the company if it wants to achieve its objectives (Derrouiche et al. 2010). It is necessary to respond to the requirements and needs of the dynamic business environment as well as monitor and control the results of the stakeholder relationship management, to take appropriate actions, remove dissatisfaction and uncertainties. When a company succeeds to manage stakeholders effectively, and manages to develop good relations with all stakeholders, and thus acquires a good reputation, it will influence to creating a good attitude towards the company and greater support. This will further lead to an advantage over the competition. E-business technologies can significantly help in achieving this goal. They need to be implemented to greater extent, and Falc needs to recognize a need for this aspect of innovation if it wants to stay competitive in the future.

REFERENCES

Aydin, G., Cattani K., & Druehl, C. (2014) Global supply chain management. *Business Horizons*, 57, 453-457

Chituc, C., Toscano, C., & Azevedo, A. (2008) Interoperability in Collaborative Networks: Independent and industry-specific initiatives – The case of the footwear industry. Computers *in Industry* 59, 741–757

Derrouiche, R., Neubert, G., Bouras, A., & Savino, M. (2010) B2B relationship management: a framework to explore the impact of colaboration. *Production Planning & Control*, 21:6, 528-546

Bureau veritas (2016) Etica, sostenibilitá e comunicazione nella filiera degli acquisti, Retrieved from: http://www.bureauveritas.it/KqxDPSKB/ATTI_iBV82_Strasserra.pdf

Franzoni, S. (2005) Le ralazioni con gli stakeholder e la responsabilitá d`impresa, preuzeto sa: http://www.unibs.it/sites/default/files/ricerca/allegati/Paper49.pdf

Il Manuale dello Stakeholder Engagement (2005)Retrieved from: http://www.accountability.org/images/content/2/0/205.pdf

Mazzola, E., Bruccoleri, M., & Perrone, G., (2015) Supply chain of innovation and new product development. *Journal of Purchasing & Supply Management* 21, 273–284

Milinović, S., Đokić, D. & Labus, A. (2014) Supply chain management in footwear industry, *Symorg 2014.*

Reijonen, H., Hirvonen, S., Nagy, G., Laukkanen, T., & Gabrielsson, M. (2015) The impact of entrepreneurial orientation on B2B branding and business growth in emerging markets. *Industrial Marketing Management* 51, 35–46

Risso, M. (2010) I servizi finanziari delle grandi imprese commerciali al dettaglio, Retrieved from: http://www.unimib.it/upload/gestioneFiles/Symphonya/lastita/f20101/rissoita12010.pdf

Schenkeln, M., Krikke, H., Caniëls, M., & Laan, E. (2015) Creating integral value for stakeholders in closed loop supply chains. *Journal of Purchasing & Supply Management* 21, 155-166

IMPLEMENTATION OF QUALIFIED ELECTRONIC SIGNATURE IN THE PROCESS OF CREATING TECHNICAL DOCUMENTATION

Miljana Novarlić*[1], Rastko Martać[1]
[1]Jaroslav Černi Institute for the Development of Water Resources
*Corresponding author, e-mail: miljananovarlic@gmail.com

Abstract: *Signing of technical documentation in paper with personal signature in ink and certifying with personal license seal has been changed and improved with digital signing of electronic document with qualified electronic signature. Purpose of the paper is to present the process of issuing qualified electronic certificate and illustrate a model for practical implementation of qualified electronic signature in the process of creating technical documentation within the process of application for electronic building permits.*

Keywords*: electronic signature, digital certificate, electronic document, electronic building permit, technical documentation*

1. INTRODUCTION

Digital world has influenced ordinary life of each and every individual as well as of legal entity. Internet revolution and new technologies has modified the way business processes are being conducted. Legal entities now have possibility to work on more efficient and transparent level. All those factors have provided a support to the government to determine internal communication as well as interaction with citizens and organizations on one new level. E-government is defined as providing public administration services to the citizens and organizations electronically (Radenković, Despotović-Zrakić, Bogdanović, Barać, & Labus, 2015). Strategy for Development of Information Society in Republic of Serbia until 2020 predicts that on or before 2020 all citizens will be able to electronically contact with government bodies, holders of public authority, courts and health protection system (Stategija razvoja informacionog društva u Republici Srbiji do 2020. godine, 2010).

As per the data published by Statistical Office of the Republic of Serbia for the year 2015 in the Republic of Serbia over 2,950,000 individuals use Internet every, or almost every day (Republički zavod za statistiku Srbije, 2015). When it comes to the electronic services of public authority (e-government) the research has shown that over 1,500,000 individuals and 94.5% of legal entities use aforementioned services.

From the 1st January 2016 one new service has been started – e Permits - Portal for electronic applications for construction permits. This portal, that is available within the Serbian Business Register Agency system (Agencija za privredne registre, 2016), has been developed within the process of implementation of the unified procedure. Unified procedure is a set of procedures and activities that are being executed by competent authority in relation with construction, upgrade or reconstruction of the object, i.e. execution off work (Zakon o planiranju i izgradnji, 2015). The aim of the procedure and implemented service is to establish the mechanism that provides functional allocation of duties within the administrative processes between citizens and government (Vasiljević & Čukić, 2016).

Precondition for using the above mentioned service is that user have issued, valid qualified electronic signature.

2. BASIC TERMS AND LEGAL BACKGROUND

The Law on Planning and Construction of Republic of Serbia defines that exchange of documents and submissions in unified procedure is conducted in electronic form and all related acts, including technical documentation is provided in the form of an electronic document in PDF format, signed with a qualified electronic signature (exceptionally, the technical documentation is provided also in dwg or dwf format, without the obligation of the digital signing) (Zakon o planiranju i izgradnji, 2015). In cases where the verification of the technical documentation or parts of the technical documentation is required by the project organization as well as by responsible and chief designer, with signature and seal of the project organization, or personal licenses seal, electronic document, in addition to being signed by a qualified electronic signature of the responsible person of project organization, or responsible or chief designer, contains digitized seal of design organization, i.e. personal licenses seal.

2.1. Qualified Electronic Signature

Electronic document, as per the Law on electronic document, has been defined as a set of data, consists of letters, numbers, symbols, graphical, audio or video records contained in application, written conclusion, document or any other act that is created by legal entity or individual or government authority in legal transaction or in administrative, judicial or other proceedings by the authorities, if made electronically, digitized, sent, received, stored or archived on electronic, magnetic, optical or other media (Zakon o elektronskom dokumentu, 2009).

The same Law (Zakon o elektronskom dokumentu, 2009) gives the meaning of the term digitalization - converting document from other forms into the digital form.

Electronic signature is a set of data in electronic form that are joined or logically connected with electronic document and that are used for signatory identification (Zakon o elektronskom potpisu, 2004).

The qualified electronic signature is an electronic signature that reliably guarantees the identity of the signatory, the integrity of electronic documents, and prevents subsequent denial of responsibility for their content. (Zakon o elektronskom potpisu, 2004). In order to be qualified, electronic signature must meet the following requirements:

- It is solely linked to the signatory
- Unequivocally identifying the signatory
- It is created using means that the signatory can independently manage and which are exclusively under the control of the signatory
- It is directly linked to the data to which it relates in a manner that unambiguously provides an insight into any changes of source data
- It is formed by the means for creating qualified electronic signatures
- It has been checked on the basis of qualified electronic certificate signer

Digital certificate is an electronic document which represents Identification Card in digital world i.e. Digital Identification Card (Digitalni sertifikati, 2016). The Government has regulated the issuing of qualified digital certificates through Certification Authorities (CA). Each qualified digital certificate contains user's and issuer's data, thus it is a document that confirms relation between data for verification of the digital signature and the identity of the signatory that has been published by CA.

Digitized seal is formed by transferring the stamp on paper into electronic form, or by scanning a paper on which is the stamp.

2.2. Technical documentation

Technical documentation is a set of projects that are developed in order to determine concept of object, elaboration of conditions, method of object construction and for the purpose of maintaining object (Zakon o planiranju i izgradnji, 2015).

There are several types of technical documentation (Vasiljević & Čukić, 2016):

- Main Design
- Preliminary Solution
- Preliminary Design
- Construction Permit Project
- Project for Executing Construction Works
- Built Design

Regardless the type of technical documentation, it includes:

- Main Notebook and
- Projects

Projects in addition may include elaborations and studies.

2.3. Legal framework in Europe with example of best practice

Digital signature technology is most often used in order to determine the document origin. In general, digital signature is a legal act that can confirm signatory identity and that the signatory has recognized the content of the file (Huang & Zhang, 2013). Most of the countries have defined standards and regulations within this area in order to assure authenticity, integrity and non-repudiation when said signatures are applied (Breier & Pomothy, 2015).

In 1999 European Union has passed Directive on electronic signatures (Directive 1999/93/EC, 1999), that represents legal base for implementation of electronic signatures for the member countries as well as for other countries that have adopted their legal framework in accordance with mentioned directive.

In 2014 European Parliament and Council have passed Directive (EU) No 910/2014 on electronic identification and trust services for electronic transactions for the inner market (eIDAS Directive) that repeals previously mentioned Directive 1999/93/EC and provides a comprehensive legal framework for electronic identification and authentication of services (Regulation (EU) No 910/2014 EC, 2014). Directive aim is to develop system of mutual recognition of national identification systems of member countries and to provide improvement of efficiency and trust within the European inner market for public and private cross-border electronic services and e-commerce.

eIDAS Directive provides mutual recognition of electronic trust services (electronic signature, electronic seal, time stamp, electronic registered delivery, website authentication) and electronic documents (Berdić, 2015).

eIDAS Implementation chronology is presented in table below.

Table 1: eIDAS implementation chronology (adopted from **(Berdić, 2015)**)

Date	eIDAS regulations
September 17, 2014	Directive has entered into force
September 18, 2015	Period of voluntary recognition of eIDAS regulation
July 1, 2016	Implementation of rules for trust services
July 1, 2017	Qualification authority shall submit a conformity assessment report to the supervisory body in order to stay as QA
September 18, 2018	Mandatory recognition of eIDAS

As per the data of Doing Business Report 2015 Republic of Macedonia is ranked on the first position in Europe and Central Asia for the system for issuing building permits (Doing Business, 2015). Application of electronic signatures in construction area has been started from 2013 and as per the statements of Chamber of certified architects and certified engineers of Republic of Macedonia, all active engineers in Republic of Macedonia have qualified electronic signature and for the period of two years it has been submitted 8.700 applications through the subject system.

3. ISSUING OF QUALIFIED ELECTRONIC SIGNATURE

Within the Register of certification authorities there are six Certification Authorities (CA) that are accredited for issuing digital certificates (Vulić & Prodanović, 2014):

- CA Post
- CA Ministry of Interior Affairs of Republic of Serbia (CA MUP RS)
- CA Ministry of Defense and Military of Republic of Serbia
- CA Chamber of Commerce of Serbia
- CA Halcom (HALCOM BG CA)
- CA E-Smart System (ESS CA)

Certification Authorities issue qualified electronic certificates to individuals and legal entities and for the needs of organization in which the certification authorities are formed. Except CA MUP RS, all certification authorities are commercial and issue resource certificates and certificates that are oriented on area of their business

Certification Authority of Ministry of Interior Affairs issues qualified digital certificates on ID card with chip, without any cost. Procedure of issuing qualified digital certificate is not significantly different among other certification authorities in terms of submission of request, selecting the media, expiration date of certificate and the amount of cost.

Implementation of qualified digital signature in the construction has been started from 2016, upon the entry on the force of the Law on planning and Construction of Republic of Serbia. Electronic unified procedure includes centralized information system (System for application of electronic submissions) with an aim to improve efficiency and transparency of the process of issuing electronic building permits. For the first three months of 2016 in Republic of Serbia have been issued 725 electronic building permits, as it was stated by the the-then Minister.

According to the Review of 10 most common mistakes of applicants of the requests in unified procedure that has been published on 19th April 2016 on the web site http://gradjevinskedozvole.rs/ on the first place is that submitted documents are not certified with qualified electronic signature. Second most common mistake is that technical documentation is not submitted in dwg or dwf format. Later on, the sixth ranked mistake is the absence of digitized seal of project organization, responsible and chief designer and the seal of the investor on the attachment of the decision of appointment chief designer. With rank eight is that attached digitally signed documents in PDF are missing personal signature in ink of responsible and chief designer.

Having in mind all above mentioned issues of implementation of qualified electronic signature within the process of creating the project and technical documentation, there is an obvious need for more detailed presentation and explanation of procedure of model for digital signing of technical documentation.

4. MODEL OF DIGITAL SIGNATURE APPEARANCE

Traditional model of signing the technical documentation was the process that have included several steps:
- Creating the technical documentation
- Printing the technical documentation
- Signing and applying the seal on multiple pages within the technical documentation by several persons
- Scanning the technical documentation
- Delivering technical documentation in person or sending the by mail/courier, or sending by electronic communication means

Now, with the possibility of implementation of the qualified electronic signature, the aforementioned process has been improved - shortened and accelerated, and include only three steps:
- Creating the technical documentation
- Applying the qualified electronic signature into the technical documentation
- Sending the technical documentation by electronic communication means

The following model provides to engineers who poses license that within presentation of data of qualified electronic signature integrate digitized personal license seal and signature.

Model of data presentation of qualified electronic signature assumes that following conditions are fulfilled:
- Signatory has valid qualified electronic certificate
- Signatory has at least one engineering license
- On the signatory's computer all necessary software and hardware for qualified electronic signing is installed and set up
- Technical documentation is prepared in PDF, i.e. PDF/A form.

Model has been developed in the last version of Adobe Reader DC software that can be downloaded for free from the official website. Adobe Reader DC allows digitally signing of PDF (PDF/A)

After the program installation it is necessary to set up few parameters within the program in order to certify PDF document with qualified electronic signature.

One of the steps referees to setting up the signatory appearance, which is the subject of the said model.

Model is based on the following steps:
- Scanning personal license seal and signature and saving in PDF form
- Within the setting up program parameters, selecting the item Edit, and in the dropdown menu selecting Preferences option.
- In the Preferences form, select category Signatures.
- Field Creation and Appearance provides setting up appearance of the data of qualified electronic signature
- Selecting the option Create New Appearance

Considering the possibility of creating several different appearances of data of digital signature, it is necessary to define unique name to the subject appearance, in order to provide easier access in the moment of signing.

Within the graphical configuration field, it is necessary to select the option Imported Graphic, and to upload previously created PDF which contains scanned personal signature in ink and personal license seal.

After this step, unchecking all offered attributes that refers to text configuration.

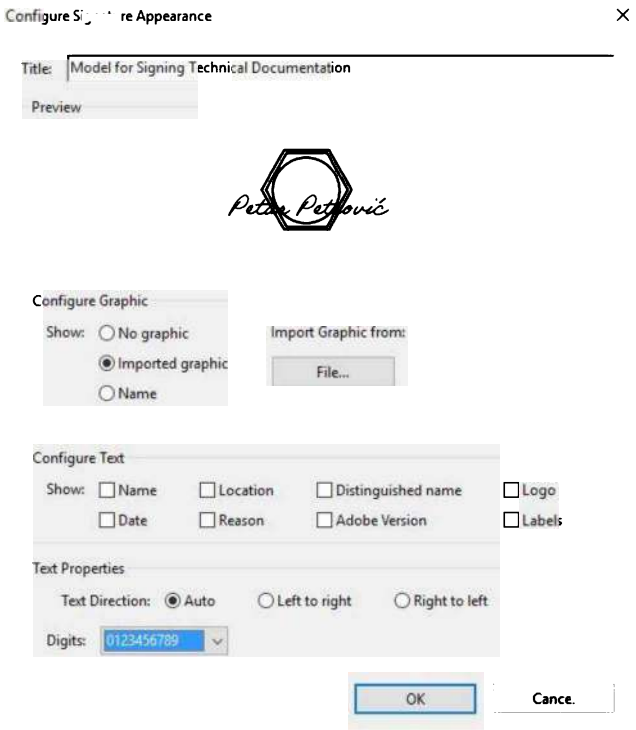


Figure 1: Creating Appearance for Digital Signature

The following paragraph briefly describes procedure that includes standard steps of the process of digitally signing of PDF documents with qualified electronic certificate, and it is also applicable to the technical documentation.

- Previously prepared technical documentation saves in PDF form
- Connect Smart Card Reader with PC and insert the smart card, i.e. connect USB token to PC
- In Adobe Raeder DC program, in the Tools section, select option Add Signature
- Select the area on the PDF where the signature data will appear
- Select previously described and defined appearance - Model for Signing Technical Documentation and confirm the selection
- Enter the Private Identification Number code (PIN code)
- Save digitally signed technical document.

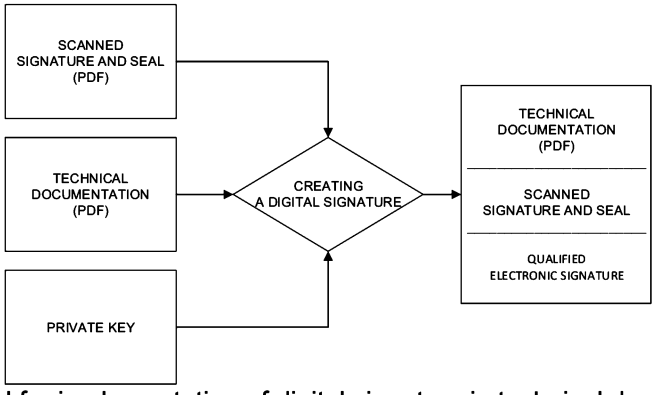


Figure 2: Model for implementation of digital signature in technical documentation

This kind of approach provides to the signatory to secure also the appearance of his personal data on the digitally signed document. PDF document, i.e. technical documentation, now contains all necessary elements as it is stipulated and regulated with respective Laws and Regulations. It is understood that the signatory has the unique access to his digital signature and personal license seal, and by integration of traditional and modern process of signing, the model acquires its practical implementation.

5. CONSLUSION

Advantages of the model are as follows:

- Model integrates traditional way of signing the technical documentation with a modernized way of electronic signing
- The model is flexible and adaptive to other systems
- The model is in accordance with the Laws
- The implementation of the model is simple
- Model offers the possibility of having an identical document in paper form and document in electronic form

From another point of view, the model has certain disadvantages:

- A qualified electronic signature increases the file size by 0.7 MB in average
- It is necessary to pre-define space for displaying data of qualified electronic signatures, in order to maintain the proportion of display stamp and handwritten signature

Having in mind the fact that the technical documentation consists of several parts and that every single part is being signed by several engineers, the question in the matter is the size of the final PDF document generated after adding all qualified electronic signatures.

From the one point of view, the Regulation stipulates that the technical documentation has to be signed and certified with personal signature in ink and sealed with personal license seal on all the places where predicts the Regulation, and the document also have to be digitally signed only once. This method means that the technical documentation should be previously prepared and printed, after which it is being signed with personal signature in ink and certified with seal for all involved engineers and responsible persons, then it is scanned, so finally, in the end it is being signed with qualified electronic signature.

From the other point of view, one of the objectives of the implementation e Permits service is the improvement of the efficiency of the process of issuing building permits and cost reduction.

The presented model has already, to some extent, found its practical application, which can be determined by examining the records of the Central Registry of the unified procedure.

In the future, it is expected the harmonization of the national Laws of Serbia with the European Directive in terms of digitalization of the seal and integration of the centralized information system for electronic building permits with the unique database of engineers.

REFERENCES

Agencija za privredne registre. (2016). *Sistem za elektronsko podnošenje prijava*. Preuzeto sa eDozvole: https://ceop.apr.gov.rs/eregistrationportal/

Berdić, D. (2015). *Prezentacija.* Preuzeto sa CA PKS: http://217.24.23.93/SADRZAJ/Files/Sertifikaciono%20telo/Seminar%20septembar%202015.pptx

Breier, J., & Pomothy, A. (2015). Qualified Electronic Signature via SIM Card Using JavaCard 3 Connected Edition Platform. *2014 Ninth International Conferenece on availability, reliability and security (ARES)*, 349-355. Univ Fribourg, Fribourg, Switzerland.

Čukić, D., & Vasiljević, D. (2016). *Vodič kroz dozvole za izgradnju.* Preuzeto sa Građevinske dozvole: http://gradjevinskedozvole.rs/Files/00283/Vodic-kroz-dozvole-za-izgradnju.pdf

Digitalni sertifikati. (2016). Preuzeto sa CA MUP RS: http://ca.mup.gov.rs/digitalni-sertifikati.html

Directive 1999/93/EC. (1999). Retrieved from Eur-Lex Europa: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A31999L0093

(2015). *Doing Business.* World Bank Group.

Huang, L., & Zhang, X. (2013). Preliminary Study on Digital Signature Technology and Application. *Resoursces and sustainable development, PTS 1-4*, 3158-3162. Guilin, Peoples R China.

Radenković, B., Despotović-Zrakić, M., Bogdanović, Z., Barać, D., & Labus, A. (2015). *Elektronsko poslovanje.* Beograd: Fakultet organazacionih nauka.

Regulation (EU) No 910/2014 EC. (2014). Retrieved from Eur-Lex: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2014.257.01.0073.01.ENG

Republički zavod za statistiku Srbije. (2015). *Upotreba informaciono komunikacionih tehnologija u Republici Srbiji.* Preuzeto sa Republički zavod za statistiku Srbije: http://webrzs.stat.gov.rs/WebSite/repository/documents/00/01/85/78/ICT2015s.pdf

Stategija razvoja informacionog društva u Republici Srbiji do 2020. godine. (2010). Retrieved from Digitalna agenda: http://www.digitalnaagenda.gov.rs/media/docs/strategija_razvoja_informacionog_drustva_u_republici_srbiji_do_2020-_godine.pdf

Vasiljević, D., & Čukić, D. (2016). *Vodič kroz dozvole za izgradnju: od ideje do upotrebe objekta.* Preuzeto sa Gradjevinske dozvole: http://gradjevinskedozvole.rs/Files/00283/Vodic-kroz-dozvole-za-izgradnju.pdf

Vulić, I., & Prodanović, R. (2014). *Comparative analysis PKI in Serbia.* Retrieved from infotech.rs: http://www.infotech.org.rs/blog/wp-content/uploads/43.pdf

Zakon o elektronskom dokumentu. (2009). Preuzeto sa paragraf.rs: http://www.paragraf.rs/propisi/zakon_o_elektronskom_dokumentu.html

Zakon o elektronskom potpisu. (2004). Preuzeto sa E - potpis: http://epotpis.mtt.gov.rs/download/propisi-epotpis/Zakon_o_elektronskom_potpisu.pdf

Zakon o planiranju i izgradnji. (2015). Preuzeto sa Gradjevinske dozvole: http://gradjevinskedozvole.rs/Files/00099/Zakon-o-planiranju-i-izgradnji.pdf

MANAGEMENT INFORMATION SYSTEMS: E-LEARNING AT THE UNIVERSITY OF NOVI SAD

Ugljesa Marjanovic*[1], Nemanja Tasic[1], Bojan Lalic[1]
[1]University of Novi Sad, Faculty of Technical Sciences, Trg Dositeja Obradovica 6, Novi Sad, Serbia
*Corresponding author, e-mail: umarjano@uns.ac.rs

Abstract: *With the advances of information-communication technologies and its intensify usage, it is critical to assess and improve the efficiency and accuracy of management information systems. E-Learning platforms are utilized by many universities to improve information exchange, communication, student collaboration, as well as to better support learning management. Owing to limited IT budget and the need to justify the investment in e-learning platform, assessing the benefits of these is an important filed in research and practice. Accordingly, this study proposes an integrated model for evaluating the effectiveness of e-learning platform from a student point of view. This model is based on updated DeLone and McLean IS success theory. Structural Equation Modeling (SEM) methodology is applied on responses from students' who used Moodle e-learning platform at the University of Novi Sad, Serbia. System quality positively influence user satisfaction. Academic institutions can use the results of this research to assess the success of their e-learning platform implementations from their students' perspective.*

Keywords*: E-learning, IS success, DeLone and McLean, SEM, Moodle*

1. INTRODUCTION

With the advances of information-communication technologies and its intensify usage, it is critical for Universities to assess and improve the efficiency and accuracy of e-learning information systems. E-Learning platforms are utilized by many universities to improve information exchange, communication, student collaboration, as well as to better support learning management. Owing to limited IT budget and the need to justify the investment in e-learning platform, assessing the benefits of these is an important filed in research and practice.

The e-learning systems have received excessive attention in information systems (IS) literature and are mainly examined from the standpoint of effectiveness (successfulness) (Marjanovic, Delić, & Lalic, 2015). Since e-learning systems are type of Information System (IS) (Chen, 2012; Hassanzadeh, Kanaani, & Elahi, 2012) they can be assessed with the updated DeLone and McLean (D&M) IS success model. The model is applicable to the assessment of IS effectiveness in the Internet environment (DeLone & McLean, 2003).

This study presents an empirically validated model for measuring the success of an e-learning system at the University of Novi Sad by using the D&M IS success model. The focus is on testing a model to assess the success of e-learning systems by quality triad constructs and their impact on user satisfaction. The proposed instrument can be used to assess the success of university e-learning systems from the perspective of the students.

2. E-LEARNING EFFECTIVENESS

2.1. Applicability of the updated D&M model

The updated D&M (2003) IS success model consists of six interrelated and interdependent dimensions of IS success: system, information, service quality, system use, user satisfaction and net benefits (see Fig. 1). The revised D&M model is one of the most widely used models of information-systems success and has been used for various information systems: e-learning (Chen, 2012; Hassanzadeh et al., 2012; Marjanovic et al., 2015), mobile data services (Shin, Lee, & Lee, 2016), IS among SMEs (Ghobakhloo & Tang, 2015), electronic Portfolio (Balaban, Mu, & Divjak, 2013), e-government (Stefanovic, Marjanovic, Delić, Culibrk, & Lalic, 2016; Wang & Liao, 2008). The model is applicable to the assessment of information system's effectiveness in the World Wide Web environment.

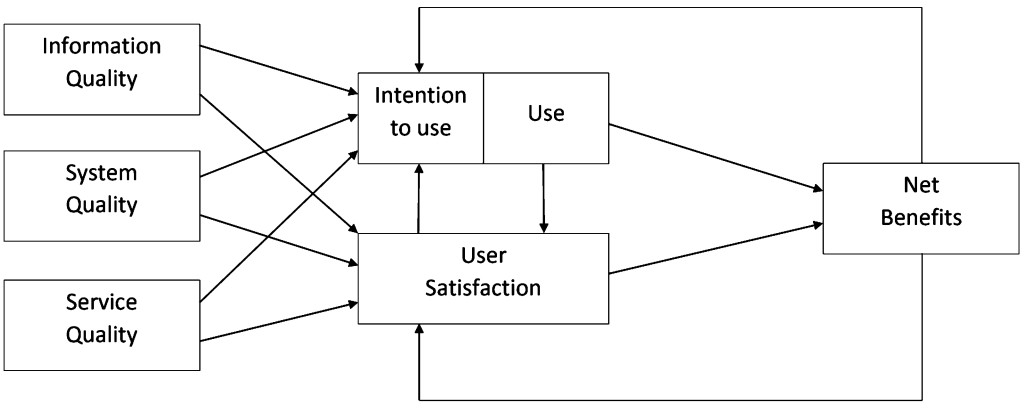


Figure 1: The updated DeLone and McLean IS success model (DeLone & McLean, 2003)

2.2. User Satisfaction

User satisfaction is one of the key components of success (Urbach, Smolnik, & Riempp, 2010) and can be defined in different ways. User satisfaction is the basic idea of the individual about the system (Wang, Wang, & Shee, 2007). Other authors define user satisfaction as a feeling of satisfaction or dissatisfaction arising from all the advantages that a user hopes to gain from interacting with the information system (Shin et al., 2016). User satisfaction represents feedback of a user after using the system, in other words, what an individual thinks and feels about the system (Marjanovic et al., 2015). Various instruments have been developed to measure user satisfaction and has not established a consensus, which would be the best instrument for measuring user satisfaction. The authors emphasize that the user satisfaction key dimension of success, but they are necessary and other dimensions to measure the success of information systems (DeLone & McLean, 2003).

2.3. Quality triad

As the e-learning platform becomes increasingly important in communication between the academic institutions and its students, it is essential for faculty personnel to provide quality services that minimize adoption barriers and maximize benefits. The D&M model suggests that the quality triad contains three elements that are important to the success of any information system: system, information and service. While this triad is composed of three elements, each can be considered individually to determine the strengths on which the academic institution capitalizes and shows where they need to make improvements.

System quality represents the technical quality of e-learning platform and measures technical success (DeLone & McLean, 2003). A higher system quality is expected to lead to higher user satisfaction, thus leading to positive impacts on individual productivity (Dong, Cheng, & Wu, 2014). For instance, if an e-learning webpage requires an extra click from the user, it might make a difference to, or have a lasting psychological impact on the user. Thus, the effect of system quality as a motivator in facilitating user satisfaction increase may be significant. System quality was measured in terms of ease of use, user friendliness and functionality (Dong et al., 2014; Marjanovic et al., 2015).

The content that an e-learning platform or information system has the more successful it will be due to more recurrent visits (Dong et al., 2014). Information quality, the quality of the information provided to the users by IS (Petter, DeLone, & McLean, 2013), is considered to be a key factor affecting IS success. Information is the reason most students use e-learning platform. In the e-learning platform context, information quality insinuates delivering up-to-date, useful and complete information (DeLone & McLean, 2003; Dong et al., 2014). It is proposed that the higher the quality of information, the more potential students would visit and browse e-learning platform.

Service quality refres to quality of service that users of an e-learning system receive from IT personnel (Petter et al., 2013). In addition to system and information quality, this construct measures the general quality of an e-learning system from the perspective of readiness of personnel to provide proper service, safety of transactions when using the e-learning system, availability of the system to users, individual attention of IS personnel and providing specific needs for users.

2.4. Conceptual model and hypothesis

In this paper, we tried to use the concepts and models mentioned in similar studies, taking into account the views of students, and provide a model for measuring the e-learning effectiveness, extending previous research. As e-learning system is considered to be an aspect of IS (Marjanovic et al., 2015), their success can be analyzed with the updated D&M IS success model. Based on a review of previous research results (Chen, 2012; Hassanzadeh et al., 2012; Marjanovic et al., 2015), we designed the initial conceptual model, presented in Fig. 2.

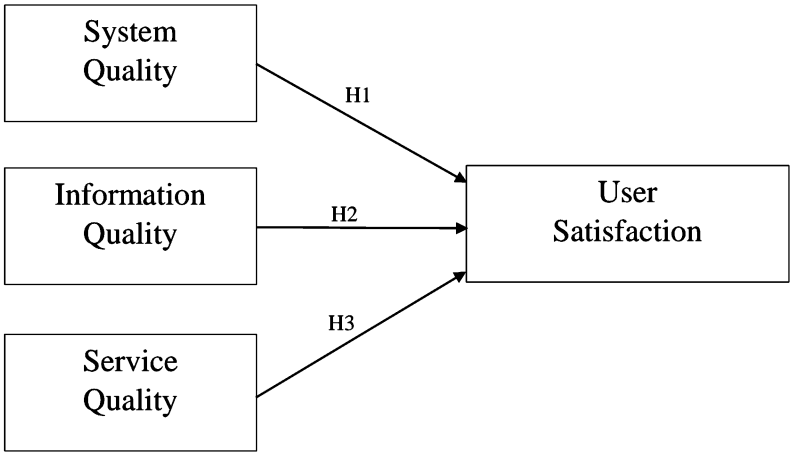


Figure 2: Conceptual Model

According to the Fig. 2, four dimensions from the updated D&M are used in this study: the quality triad elements and user satisfaction. Our hypotheses about the relationships in the model are presented below:

H1: System quality of e-learning system has a positive effect on user satisfaction of students

H2: Information quality of e-learning system has a positive effect on user satisfaction of students

H3: Service quality of e-learning system has a positive effect on user satisfaction of students

3. MATERIALS AND METHODS

The data used to test the conceptual model were obtained from a sample of senior students from the Faculty of Technical Sciences (FTS), University of Novi Sad, Serbia. The focus was on students that have used the faculty e-learning system Moodle. Following Dillman's et al. (2014) recommendations of applying the total design method of surveys, we emailed 500 students via the SurveyMonkey online survey tool. A total of 165 responses, that were using e-learning system Moodle during winter semester, were received over a period of ten weeks, representing a response rate of 33%. After conducting non-engaged bias analysis, 17 responses were deleted and the remaining 148 useful responses were available for data analysis, yielding a 29.6% usable response rate. Approximately, 68% of the respondents were female. Age distribution was as follows: under 23 (77.0%), between 24 and 28 (18.2%), between 29 and 33 (2.7%), and over 33 (2.0%). Detailed descriptive statistics relating to the demographic characteristics are shown in Table 1.

Table 1: Demographic details of the respondents (n = 148)

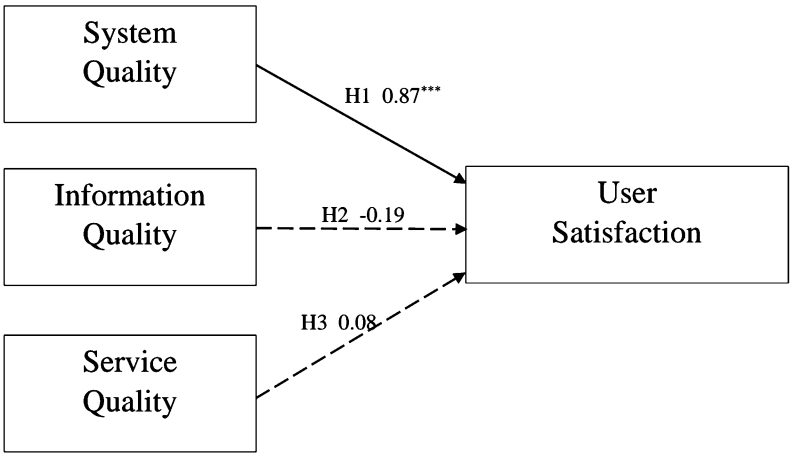
Measure	Items	Frequency	%
Gender	Male	48	32.4
	Female	100	67.6
Age	<23	114	77
	24-28	27	18.2
	29-33	4	2.7
	>33	3	2.0

4. RESULTS

In general, the Structural Equitation Modeling (SEM) technique was conducted in SPSS Amos to examine the model fit for each construct (to assess the measurement model) and to test the relationships among the constructs (to test the hypotheses in the structural model).

Reliability was evaluated by calculating Cronbach's alpha coefficients (Nunnally & Bernstein, 1994). The reliability of each factor collected by the survey instrument was as follows: system quality = 0.853; information quality = 0.843; service quality = 0.939; user satisfaction = 0.943. And the reliability of the whole instrument was 0.947. In addition, the reliability and convergent validity of the factors were estimated by the Composite Reliability (CR) and Average Variance Extracted (AVE). All the Cronbach's alpha coefficients and composite reliability values satisfied the minimum criterion value of 0.70 or greater, as suggested by Hair et al. (2009). The average variances extracted were all above the recommended 0.50 level (Hair et al., 2009), which meant that more than one half of the variances observed in the items were accounted for by their hypothesized factors. CR was greater than AVE for each factor. Thus, all the factors in the measurement model had adequate convergent validity. Discriminant validity can be evaluated by examining the Average Variance Extracted (AVE), Maximum Shared Variance (MSV), and Average Shared Variance (ASV). Following the Hair et al. (2009) recommendation, MSV not greater than AVE, ASV not greater than AVE, and Square root of AVE greater than inter-construct correlations will lead to discriminant validity. None of the factors had convergent validity concerns. In summary, the measurement model had adequate reliability, convergent validity, and discriminant validity.

The following set of fit indices was used to examine the structural model: ($\chi 2$=169.00 with df=84, AGFI=0.819, NFI=0.911, CFI=0.952, RMSEA=0.081). All fit indices values are in the acceptable range, indicating a good fit of the model. The standardized path coefficient, p-values, z-scores, and variance explained are shown in Figure 3.



Note. statistically significant ——; statistically non-significant -------; ***p < 0.001

Figure 3: Structural model

System quality is related to user satisfaction (β = 0.87, p < 0.001), providing support for hypotheses 1. Information quality and service quality are not related to user satisfaction (β = -0.19, p > 0.05; β = 0.08, p > 0.05), thus, hypothesis 2 and 3 are not supported.

Henseler et al. (2009) suggested using the coefficient of determination (R^2) of the endogenous latent variables as the essential criterion for structural model assessment. R^2 was 60% when the quality triad was used to predict the user satisfaction.

5. DISCUSSION

Based on our model and structural equations, it can be said that technical system quality is one component of measuring the success of an e-learning system in a university and, through a direct effect on user satisfaction, it can also affect the success of these systems. Hence, whenever the technical quality of an e-learning system is higher, user satisfaction of the e-learning system is higher. Instructors and system designers should make full use of user friendliness, ease of use, and functionality of the system to increase user satisfaction when it

comes to e-learning systems. This is in line with previous research that also found a positive influence of system quality on the user satisfaction (Hassanzadeh et al., 2012; Marjanovic et al., 2015).

This study presented an empirically validated model for measuring an e-learning system success. Our instrument can be utilized to assess the success of university e-learning systems from the student perspective. This evaluation will provide fast and prompt feedback to the university. IS managers that are handling e-learning processes within the university can use taxonomy that consists of system quality, information quality, service quality and user satisfaction, to improve their understanding of the level of e-learning success and take corrective actions for enhancement if necessary.
E-learning managers responsible for developing and implementing e-learning systems at the university can use the proposed model which consists of the system quality, information quality, service quality and user satisfaction, to improve their understanding of the success of these systems and, if necessary, successfully undertake corrective measures for improvement. Based on the relationships in the model, universities can assess to which dimensions they need to pay close attention to improve the success of the implementation and students' satisfaction from the e-learning system. For instance, if the instrument indicates satisfaction as a problematic dimension, the university can take advantage of that to improve the quality of the system in order to improve student satisfaction and make the e-learning system more effective.

The audit process and its application to the example of the e-learning system does not differ greatly from other IS in the organization. All IS within the organization should be fully integrated, that is routinized into the organizational processes, to produce the expected benefits (Armstrong & Sambamurthy, 1999). Bearing in mind that the audit process usually takes from 6 months to 1 year after initial implementation (Markus & Tanis, 2000), IS success assessment is twice recommended in the first year. Afterwards, if the results are satisfactory, the instrument could be administered on an annual basis, after each school year.

6. CONCLUSION

This research paper examined the IS success of a faculty e-learning system on the individual level of analysis from the students' perspective. A field survey was conducted at the Faculty of Technical Sciences, University of Novi Sad, Serbia to test the model. The empirical results verified the validity of the D&M success model in the context of e-learning in the transitional country such as Serbia. Our analysis showed that only one out of three quality dimensions (i.e., system quality) had a positive impact on user satisfaction.

Limitations to this study are in the areas of sampling. The sample was drawn from a highly homogenous group belonging to a single faculty, probably lacking the diversity that can be expected from a comparable sample chosen from different universities. Future studies should be conducted to evaluate the resulting models, using a sample from the entire Serbia.

REFERENCES

Armstrong, C. P., & Sambamurthy, V. (1999). Information Technology Assimilation in Firms: The Influence of Senior Leadership and IT Infrastructures. *Information Systems Research*, *10*(4), 304–327.

Balaban, I., Mu, E., & Divjak, B. (2013). Development of an electronic Portfolio system success model: An information systems approach. *Computers & Education*, *60*(1), 396–411.

Chen, H.-J. (2012). Clarifying the empirical connection of new entrants' e-learning systems use to their job adaptation and their use patterns under the collective–individual training environment. *Computers & Education*, *58*(1), 321–337.

DeLone, W., & McLean, E. (2003). The DeLone and McLean Model of Information Systems Success : A Ten-Year Update. *Journal of Management Information Systems*, *19*(4), 9–31.

Dillman, D. A., Smyth, J. D., & Christian, L. M. (2014). *Internet, Phone, Mail, And Mixed-Mode Surveys: The Tailored Design Method.* Hoboken, NJ: John Wiley & Sons, Inc.

Dong, T.-P., Cheng, N.-C., & Wu, Y.-C. J. (2014). A study of the social networking website service in digital content industries: The Facebook case in Taiwan. *Computers in Human Behavior*, *30*, 708–714. http://doi.org/http://dx.doi.org/10.1016/j.chb.2013.07.037

Ghobakhloo, M., & Tang, S. H. (2015). Information system success among manufacturing SMEs: case of developing countries. *Information Technology for Development*, 1–28. http://doi.org/10.1080/02681102.2014.996201

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2009). *Multivariate Data Analysis* (7th ed.). Prentice Hall.

Hassanzadeh, A., Kanaani, F., & Elahi, S. (2012). A model for measuring e-learning systems success in universities. *Expert Systems with Applications*, *39*(12), 10959–10966.

Henseler, J., Ringle, C. M., & Sinkovics, R. R. (2009). The use of partial least squares path modeling in international marketing. *Advances in International Marketing*, *20*, 277–319.

Marjanovic, U., Delić, M., & Lalic, B. (2015). Developing a model to assess the success of e-learning systems: evidence from a manufacturing company in transitional economy. *Information Systems and E-Business Management*, 1–20. http://doi.org/10.1007/s10257-015-0282-7

Markus, M. L., & Tanis, C. (2000). The Enterprise System Experience - From Adoption to Success. In R. Zmud (Ed.), *Framing the Domains of IT Management: Projecting the Future Through the Past*,173–207. Cincinnati, Ohio: Pinnaflex Educational Resources inc.

Nunnally, J., & Bernstein, H. (1994). *Psychometric theory*. New York: McGraw-Hill.

Petter, S., DeLone, W., & McLean, E. R. (2013). Information Systems Success: The Quest for the Independent Variables. *Journal of Management Information Systems*, *29*(4), 7–62.

Shin, B., Lee, S., & Lee, H. G. (2016). Examining an extended duality perspective regarding success conditions of IT service. *International Journal of Information Management*, *36*(2), 226–239. http://doi.org/http://dx.doi.org/10.1016/j.ijinfomgt.2015.11.012

Stefanovic, D., Marjanovic, U., Delić, M., Culibrk, D., & Lalic, B. (2016). Assessing the Success of E-Government Systems: An Employee Perspective. *Information & Management*. http://doi.org/10.1016/j.im.2016.02.007

Urbach, N., Smolnik, S., & Riempp, G. (2010). An empirical investigation of employee portal success. *The Journal of Strategic Information Systems*, *19*(3), 184–206.

Wang, Y.-S., & Liao, Y.-W. (2008). Assessing eGovernment systems success: A validation of the DeLone and McLean model of information systems success. *Government Information Quarterly*, *25*(4), 717–733.

Wang, Y.-S., Wang, H.-Y., & Shee, D. Y. (2007). Measuring e-learning systems success in an organizational context: Scale development and validation. *Computers in Human Behavior*, *23*(4), 1792–1808.

IMPLEMENTATION OF THE CROWDFUNDING CONCEPT IN HIGHER EDUCATION

Nada Staletić, Petrović Vera
School of Electrical and Computer Engineering of Applied Studies,
e-mail: nada.staletic@viser.edu.rs

Abstract: *The subject matter of this study is the implementation of the crowdfunding concept in higher education. Part one of the study covers the basic characteristics of crowdsourcing and crowdfunding. Technologies necessary for the implementation of this concept have been discussed, as well as current business models and projects based on them. In part two, the possibilities for applying crowdfunding in higher education have been analyzed. The possibility of integrating the concept into formal educational flows has been analyzed in particular. Part three gives a proposal regarding the implementation of the crowdfunding concept in the School of Electrical and Computer Engineering of Applied Studies in Belgrade, on the Kickstarter platform. Paper offers a description of the most popular crowdfunding platforms to initiated project and crowdfunding project of schools and students in high education.*

Keywords: *crowdfunding, e-education, kickstarter, crowdsourcing, web 2.0*

1. INTRODUCTION

The advance of the Internet, as an information and communication technology, which is today present in all human professional and other activities, has entered a new phase at the beginning of the third millennium, known as: web 2.0. Unlike the early phase, when web contents were merely electronic catalogues intended for users, without a possibility of a more significant interaction with users, web 2.0 is based on an idea of a higher level of collaboration between users, who have the opportunity to post contents, shape the user interface and set in motion various global initiatives. Thanks to web 2.0 the Internet has become the most democratic media, because for launching an initiative into motion one needs a good idea, and the resources are often available free of charge (Jones, 2008).

Web 2.0 is the framework for the appearance of the crowdsourcing concept, which was designed several years ago and which has an increasing application in various fields of modern life. Crowdsourcing is a group of people who attempt to ensure the common good in the absence of a central body. In the case of crowdsourcing in e-education, this common good is in the form of video recordings, music or encyclopedic knowledge freely available to everyone. In the academic world, attention is the main currency within the online community, and status and acknowledgement have proven to be very important motivators for contributions.

In this study special significance is placed on crowdfunding as a model of crowdsourcing. Crowdfunding implies mass funding or raising funds from a large number of people via the Internet. Crowdfunding is a form of alternative funding, that originated outside the framework of traditional funding. In literature, crowdfunding is often referred to as funding of the 21st century.
In recent years the interest of users for crowdfunding has led to the implementation of this concept also in education. The launching of a crowdfunding project may greatly contribute to the advancement of education, especially in terms of education in underdeveloped countries.

A case study was presented in this paper which refers to the implementation of the crowdfunding concept in the School of Electrical and Computer Engineering of Applied Studies in Belgrade.

2. LITERATURE REVIEW

Crowdsourcing is an act undertaken by a company or institution in the form of an open call with the aim of transfering the function of employees and outsourcing to an undefined (and generally large) network of people, connected on the Internet (Howe, 2006).
Crowdsourcing is an online distributed problem solution and a model of business production (Brabham, 2008).

Crowdsourcing implies the existence of four main elements:
- A person, usually called the crowdsourcer, who designs, launches and manages the project (manager);
- A group of people, backers, who work on the project (crowdworkers);
- The market, usually called the crowdmarket, a place where managers and backers engaged in the project can meet,
- Sites (Internet platforms) used for implementing the process (crowdsites).

The issue of motivating the public, participants in the project, can be of crucial importance regarding the decision of an individual to participate in the project. The motivation can be personal satisfaction, review of acquired knowledge and skills, acknowledgements and awards in the form of appropriate certificates and public recognition or promotions on the Internet. Furthermore, monetary compensations can also be a motive for certain people, however, money awards for this work are usually small and depend on the complexity of the work and the amount of work put into the project.

Jeff Howe defined the taxonomy of crowdsourcing which enabled the defining of four main models (Howe, 2006):
- Collective intelligence or Crowd wisdom is one of the two most common models of crowdsourcing, where the „crowd" comes together and shares knowledge.
- Crowd creation work is an open call to the „crowd" to find new and useful solutions. It is applied when there is an insufficient number of experts in a certain field and when more different ideas are necessary.
- Crowd voting occurs when opinions on a certain topic are collected on the web, with the help of large groups of people.
- Crowdfunding is a special model of crowdsourcing. Unlike the aforesaid models, which imply that people contribute to a copyright through their work and services, crowdfunding refers exclusively to financial contributions.

Crowdfunding is an open call via the Internet for providing funds, either in the form of donations, or in exchange for some kind of award to support an initiative for special purposes (Belleflammea, Lambert & Schwienbacher, 2014). Crowdfunding refers to the attempts of entrepreneurs, individuals and groups from the field of culture, music, arts and non-profit organizations to fund their endeavors relying on relatively small contributions of a relatively large number of individuals who use the Internet, without standard financial intermediaries (Mollick, 2014).

One of the key principals of crowdfunding is the „rewarding" of donors, i.e. compensation for financial support which mainly implies that, upon the completion of the copyright project, the donors can download a film, album, video-spot or some other funded product (Bannerman, 2013). Crowdfunding is very common in the music, film and video-game industry, where individual projects probably couldn't even be carried out if their funding depended only on „corporate channels" (Poetz & Schreier, 2012).

2.1. Types of Crowdsourcing

The motivation of crowdworkers significantly contributes to the success of a crowdfunding project. It often depends on the applied type of crowdfunding. Hereinafter different crowdfunding types are presented in brief. There are four types of crowdfunding:
- Equity-based Crowdfunding – Enables the crowdworkers to fund a startup company and small enterprises in exchange for capital. Crowdworkers donate money for business operations and receive ownership of a small portion of that business.
- Reward-based Crowdfunding – Crowdworkers exchange donations for present or future products or services. Individuals or enterprises who launch a project can motivate crowdworkers by giving them various products, like tee-shirts, copies of products which are the result of a project, or even only by issuing them letters of recognition (Ahlers et al, 2015). Platforms for crowdfunding mainly differ according to whether they endorse the principle „all or nothing (AoN)" or the principle „Keep it All (KiA)". Some of them offer both solutions, and leave the choice to the crowdsourcer (the person who designs the project). In the first case, funds are withdrawn from the account of the donor only if the financial goal is achieved, and in the second case the author of the project is allocated a sum regardless of the attainment of the specified amount. Often the raised sum exceeds the initially defined goal. This type is one of the most popular and most common types of crowdfunding.
- Leading−based crowdfunding or Credit−based crowdfunding – Crowdworkers invest donations which are returned to them after a specific time period.
- Donation−based crowdfunding is a type of crowdfunding where crowdworkers as individuals donate money to charitable causes.

2.2. Platforms for initating crowdfunding

Crowdsourcing can be initiated from different Internet platforms: web sites; specialized web platforms; social networks; blogs; microblogs; and a significant role in the implementation of a project can be played by locations for multimedia sharing (YouTube; Flickr; Picasa; Pinterest). However, when it comes to crowdfunding as a model of crowdsourcing, platforms that are used for launching such projects are mainly specialized web platforms (crowdfunding platforms). The reason for this are the financial transactions carried out via such sites.

On crowdfunding platforms, the author posts their project, explains the financial goal, and then promotes the idea through video recordings or other multimedia modes, while the circle of potential donors is spread via social networks. Site visitors support the desired project by donations which they pay with credit cards for on-line purchases, and if the author managers to raise the planned amount, the crowdfunding platform takes app. 5 percent. There are several sites where individuals can safely invest money. The following sites can be regarded as such: Kickstarter, IndieGoGo, GoFindMe, RocketHub, iStockphoto, etc.

Kickstarter.com is one of the most popular crowdfunding platforms on the Internet. It has several million members who donate billions of dollars for funding creative ideas in the field of arts, music, film and video, games, design, technology etc. (Kuppuswamy & Bayus, 2015). Kickstarter is the leading crowdfunding platform in the USA where so far more than 2 billion dollars have been raised from more than 10 million crowdworkers and 100,000 creative projects have been launched (Figure 1) (Statistics on Kickstareter, 2016). Kickstarter operates on the principle of "AoN - All or Nothing", which means that the creator of the project needs to reach their financial goal before the expiration of the project.

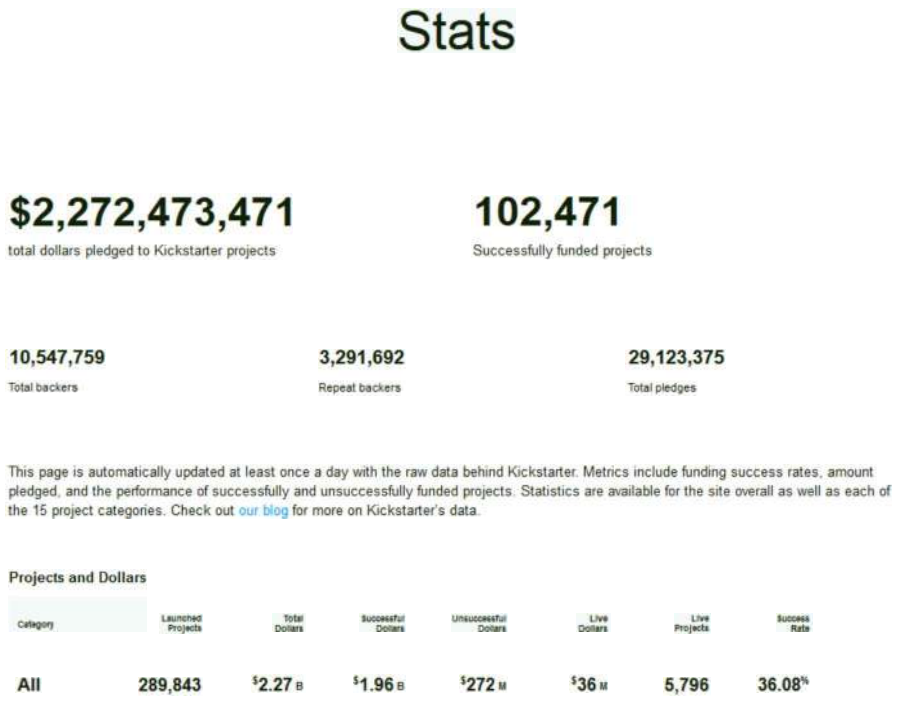


Figure 1: Review of the number of launched and the number of unsuccessful projects at Kickstarter (Statistics on Kickstareter, 2016)

On February 14, 2013, Kickstarter published an iOS application named Kickstarter for iPhone. This application is intended for users who create and donate projects. Thus, for the first time, Kickstarter acquired also a mobile version of the platform. At the end of January of this year, an application for Android OS was also created.

Kickstarter charges a commission fee of 5% of the total amount of raised funds. A payment processor calculates an additional tax of 3-5% on donations. Unlike many other forms for raising funds or investments, Kickstarter does not take ownership of projects. Web pages of projects launched on the site are permanently stored and are available on the Internet. When funding is completed, the projects cannot be altered or removed from the site.

iStockphoto.com is a web-based company which sells photographs, animations and video recordings. In order to become a photographer for iStockphoto, a user must fill out an online form, submit proof of their identity and submit three photos to be evaluated by the employees in iStockphoto. Photographers can post their photos on the site, which are stored in databases under key words (model: Crowd creation work). Visitors of the site browse through the stocks of photographs which they mostly intend to use on their web sites, brochures, business presentations etc. Those visitors of the site who are interested in purchasing, must firstly buy points (1 US$ per point) which they need to purchase photos they are interested in on the site (model: crowdfunding). The platform uses a business model of payment via credit cards (Visa, Master) and Pay Pal. Photographs of standard format and quality can be purchased for a price of one to five points, and high resolution photos, oversized photos and longer video recordings can cost up to 50 points.
Photographers receive 20% of the sale price every time one of their photos is downloaded from the web site. Some photographers, who become active members of the online community, are usually engaged for maintaining the databases, and can earn more by signing exclusive contracts with iStockphoto, where they receive 40% of the sales price for their photos. iStockphoto is a community composed of both amateurs and professionals who work in that field.

GoFundMe.com enables users to create their projects. During this process, members can explainthe goals of fundraising, can define the category, define the expected amount, can post photographs or video recordings etc. After the launching of a project on the GoFundMe platform users are given the opportunity to share their projects through integrated social networks (Facebook, Twitter etc.) or by e-mail. Also available is the GoFundMe mobile application for iOS and Android operating systems.
Millions of people have raised more than 2 billion dollars in the last 365 days.
Crowdworkers can donate money via the platform using debit or credit cards (but not PayPal, as on most other crowdfunding platforms). Those who donate can leave comments on the site as support for the project. GoFundMe generates income by automatic deduction of a 5% commission fee from every donation on the project. The compensation for processing donations is app. 3% per donation.

3. CROWDFUNDING IN E-EDUCATION

In institutions of higher education crowdsourcing is mainly used in logistics, and much less for studying and training purposes. However, use of crowdsourcing for studying and training can contribute to innovations in the teaching process and help develop learning and professional skills of students.

In terms of e-education, crowdsourcing can be defined as follows:
- A group of people (students, lecturers, administrators) who serve as a source of information, instead of depending on only one person as the authority.
- Team work focused on all members who contribute to the project by their knowledge.
- A tool used for managing ideas where ideas can come from any member of the „crowd“; everyone works together to solve a problem.

Some Universities have already launched crowdsourcing programs within their Faculties for various purposes. Information regarding subjects in all fields and disciplines are available on the Internet. According to the ComScore site, as average YouTube browser follows more than 180 online videos each month on topics like learning languages, programing and many others. Two years ago, YouTube launched YouTube EDU where many Faculties and Universities have their own channels. Visitors can find more than 125,000 videos with over 63,000 hours of recordings with different levels of academic material which can be accessed, commented and shared by students (Sclater, 2006).

When it comes to crowdfunding, as a model of crowdsourcing, in the field of education it is mainly used as a source for funding various projects, students' tuition fees, equipping of schools etc. Such crowdfunding projects can be launched on different crowdfunding platforms which offer funding in the field of education. Crowdfunding is a good way for students with good references and qualifications in underdeveloped countries to enlist in prestigious Universities, without tuition fees becoming a limiting factor (Abbey, 2013).

The first time crowdfunding appeared in university circles was in 2012, when a partnership was formed between the University of Utah and the RocketHub crowdfunding site. The first set of projects launched within the scope of this partnership raised a total of $ 32,000 and attracted more than 210 donors. The same year the University of Virginia initiated a crowdfunding platform. In addition to raising donations, they attempted to determine what motivates donors to invest in launched projects. Using crowdfunding the Universities were able even then to use their creativity and individuality, as well as the Internet, to recruit new

donors. It should be noted that the success of a crowdfunding campaign usually depends on the use of social media.

An example of using crowdfunding in education is the launching of a crowdfunding project, on the Kickstarter platform, for funding tuition fees for Emily-Rose Eastop, a master degree student at the Oxford University. The required amount defined in the project was £ 26,000, and after completion of the project the amount raised was £ 26,581. On the other hand, a master degree student, Nick Gaven, who also launched a project for funding his tuition fee on the GoFundMe platform, managed to raise only £ 700. This indicates that there are no guarantees when it comes to crowdfunding. A project should be concisely defined, the appropriate crowdfunding platform should be selected, a good promotion should be devised via social networks and other channels of Internet marketing, etc. (Llorente, Morant & Garrigos-Simon, 2015).

In recent years, budgets of higher education institutions have been reduced, thus schools have increasingly been turning to this method of fundraising. Many lecturers and students achieved success by creating crowdfunding projects on DonorsChoose.org, ClassVish and other similar crowdfunding platforms which are exclusively dedicated to funding in the field of education.

3.1. Examples of crowdfunding in e-education

Givology.org was founded in 2008 by a group of graduate students from the University of Pennsylvania. It is a crowdfunding platform where small donations are given (several dollars) as support for student projects and student scholarships in developing countries. It operates on the principle of "All or Nothing (AoN)". Givology connects donors on the Internet with non-governmental organizations and universities from all over the world, and also enables them to stay in contact through the platform blog. In addition, accounts are also created on social networks (Facebook, Twitter, LinkedIn) where there is wide interaction between students and donors.
Givology has raised over 300,000 dollars for support to more than 2,800 students in 26 countries. The goal of the site is to lower transaction fees to ensure that students receive the largest possible amount of donations. This means that a 100% of donated amounts goes to charity, while zero percent goes to covering expenses, i.e. site commission fees. Compared to other crowdfunding platforms which charge a commission fee of app. 5% of the total raised amount, this crowdfunding platform operates on a voluntary basis. Another interesting fact is that Givology has a separate fund for raising money which is used for covering banking transaction fees, which amount to 2-4% per transaction.
The Givology platform applies the Electronic Wallet principle, which simplifies the donating process. Google Wallet is used. The transfer of money into the e-Wallet is simple, and can be done in only one step. By depositing money into the e-Wallet, funds appear in the account of the donor who can then donate the funds to selected students and student projects. Donors who do not have time to search through the database of numerous students and projects, can use an option where the platform generically selects students who will receive the donation by using specific algorithms. Of course, the names of donors appear on donor lists for students and student projects. When students and projects are fully funded, Givology sends a check to a partner organization in charge of delivering funds to students or student project leaders. As intermediaries, these organizations regularly update information presented in the form of video recordings, photographs, correspondence with students etc. Givology staff then posts this information on line so that the donors can see their roles in the project, and by doing so the platform demonstrate that it promotes transparency of information.

DonorsChoose.org is a non-profit organization from the USA which enables individuals to directly donate to schools and school projects. At that time, DonorsChoose was among the first such crowdfunding platforms. Today, this site has over 2,000,000 crowdworkers, i.e. donors, and more than 690,000 funded projects involving app. 17,700,000 students.
DonorsChoose enables lecturers to post on the platform requests for necessary material and resources for their laboratories and projects, which are available to donors. Each project has a well-defined detailed description of the project, of the required budget and the necessary items for the implementation of the project. Donors can donate $ 1 or more to selected projects, which they can search by school name, lecturer's name, location, area and key words. DonorsChoose then transfers donations directly to schools where the projects were launched. This platform operates on the principle of "All or Nothing".
Of the total amount of raised funds for a specific project, the platform charges a 1,4% commission fee, while 4.4% of the total amount goes to cover transaction fees.
All donors receive photos of implemented school projects and a letter from the lecturers. Donors who donate $ 50 and more to a project receive a hand written letter of recognition from the students.

ClassVish.com is a non-profit and crowdfunding platform engaged in raising funds for equipping schools. Unlike the DonorsChoose crowdfunding platform which deals in funding higher education projects, ClassVish exclusively deals with financial aid to primary and secondary school education in the USA. On this crowdfunding platform lecturers and school principals can launch projects where they define a list of required resources for equipping their schools. Donors have the possibility to browse the site and find schools according to cities and states, according to school codes or names of lecturers who launched a project.
For covering transaction fees 2.9% and 30 cents are deducted from each donation. After the completion of the project, the ClassVish platform procures resources from the school requirement list by purchasing those resources at reduced prices from partners which have signed contracts with the platform. The difference between the reduced and regular prices is in fact the profit of the platform, i.e. the percentage its takes from every implemented project. The platform operates on the principle of " Keep it All (KiA)". When the defined time for funding a specific project elapses, the platform selects the resources which will be purchased based on the raised amount and the requirement list defined by lecturers or school principals. In case the platform is not able to purchase resources defined in the requirement list, the raised funds are paid directly to the school, reduced for 5% commission fee taken by the platform.

4. AN IMPLEMENTATION OF CROWDFUNDING IN HIGHER EDUCATION

Higher education is under the influence of constant changes. New technologies and innovations impact the concept of education forcing it to undergo constant transformations. The principle of obviousness in teaching, for the sake of a vivid understanding of the essence of the subject matter presented to students through teaching programs, has become multidimensional, with the dynamic development of digital multimedia and the possibility to virtualize and simulate a large variety of complex activities and processes, which are being studied in theoretical and applied studies of modern times. The School of Electrical and Computer Engineering of Applied Studies (VISER) in Belgrade has seven contemporary undergraduate study programs and six post-graduate study programs. It has twenty laboratories, eight of which are for general purposes, equipped with desktop computers using Windows 7, Windows 8 and Windows 8.1 operating systems, as well as 12 laboratories for special purposes, one of which is equipped with twenty Macintosh computers. Teaching activities within all study programs take place at the same location – the school building.

The School Board and the Governance Body of the School have decided to equip the ground floor auditorium, with 140 seats, and turn it into a general purpose smart classroom. Smart Classrooms represent synthesis of technology, user interface and traditional lecturing methods. New generations of Smart Classrooms are equipped with high technology and they become necessary for performing teaching processes at universities. Smart Classrooms have audio-visual equipment which enables transferring the knowledge by using a wide spectrum of different media (Gligoric, Uzelac, & Krco, 2012).
The amount of 12,000 dollars is provided by the School from its own resources. The amount of 8,000 dollars will be obtained through donations made by individuals and organizations who respond to a public call placed via crowdfunding. The project will be launched on the Kickstarter.com web crowdfunding platform. The project is launched for the purpose of fundraising in the form of donations for equipping a smart classroom. No limits are set in terms of donation amounts. The duration of fundraising through donations is limited to sixty days.
The defining of a project on the Kickstarter platform requires several steps. The first step is to define the field of the future project and its name. The name of the project is Equipping a smart classroom at VISER in Belgrade, in the field of Technology. In the next step it is necessary to input data relevant for creating an account on Kickstarter (name, e-mail address and password). There is also the possibility of logging in via a Facebook account.

As stated hereinbefore, Kickstarter is a crowdfunding platform operating on the principle of "All or Nothing (AoN)". If the project is successfully implemented, the Kickstarter platform charges a commission fee of 5% of the total amount of raised funds. There is also a 3-5% online transaction fee. More precisely, 3% + $ 0.20 per donation, except for donations under $ 10, which have a discount as micro-donations: 5% + $ 0.05 per donation.

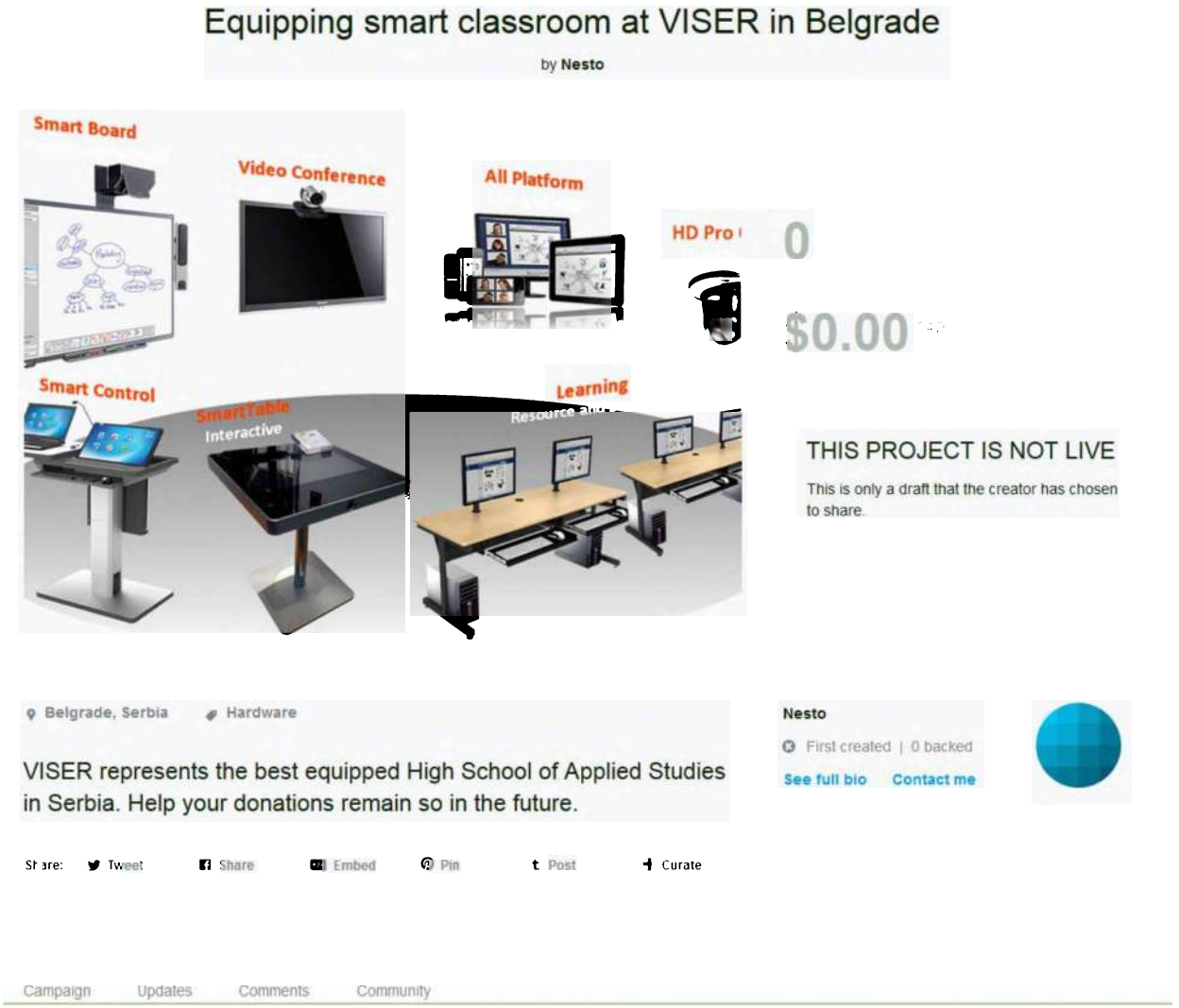


Figure 2: Launched crowdfunding project of VISER on the kickstarter.com site

Promotion via the Internet of the launched crowdfunding project on the Kickstarter platform is automatically posted and SEO optimized on the Facebook, Google+, Instagram, Twitter social networks, where the accounts were created by Kickstarter.

Once the project is created, Kickstarter informs about the rules of the platform which the crowdsourcer, i.e. the project manager must comply with. The rules are the following: the project that is being created must share something with others; the project must be reliable, clearly posted and presented; the project cannot raise funds for charitable purposes by proposing financial initiatives or presenting prohibited products/services.

Since the duration of the project is still in progress, the results will be published in one of the following research. After the implementation of smart classroom, participants in the crowdfunding project will be awarded letters of recognition for their donations and for participating in the project in a .pdf format which will be sent by e-mail. Participants in the project will also receive a cover letter containing the web address of the posted photo gallery from the opening of the smart classroom. On the School channel on the YouTube platform will be posted a short film with the mouth and the satisfaction of students, as well as the usefulness of smart classrooms.

5. CONCLUSION

Crowdfunding is a model of web 2.0, which, due to its usefulness and wide range of applications, has been undergoing intensive growth on a global level during the past few years.

Individual donations for launched crowdfunding projects influence the final financial value and outcome of the project. Each donor also contributes to the promoting of projects that their donates to and believes in. They will occasionally play the role of donors oriented towards supporting social projects and charity projects. In some cases, they will become shareholders and will contribute to the development and growth of a business. Motivation for user participation is a result of various sentiments, such as: to be at least partly responsible for the success of initiatives made by others (desire for sponsorship); to be part of a social initiative (desire for social participation); to request payment from financial contribution (desire to invest).

When it comes to the implementation of crowdfunding in education, compared to traditional forms of creating innovations or fundraising for a specific project in education, the following benefits can be pointed out:

- Easy access to flexible crowdworkers i.e. donors
- Funding of young and creative talents and support for educational institutions
- Greater efficiency (cost savings since there is no job creating; no salary payments and state contributions)
- Shorter time to enter the market and faster delivery of the project.

On a global level, today there are not many case studies regarding the application of the crowdfunding concept in the field of education. However, crowdfunding is a very flexible concept and its application in the field of education has good prospects. Education is a constantly evolving process, in accordance with curricular changes, changes in teaching methodology, new scientific disciplines and new courses.

In terms of online funding, crowdfunding is regarded as a premature conclusion. At a certain point in time, in a not so distant future, an increasing number of educational institutions, lecturers and students will launch crowdfunding projects on the Internet, which will be funded by people who they might never meet, and who will be credited for student scholarships or modernly equipped schools.

REFERENCES

Abbey R. S., (2013), The JOBS Act and crowdfunding: Harnessing the power and money of the masses, *Business Horizons*, vol. 56, issue 3, 271-275.

Ahlers et al.. (2015). Signaling in Equity Crowdfunding. *Entrepreneurship Theory and Practice*, 39(4), 955-980.

Bannerman, S. (2013). Crowdfunding Culture . *Journal of mobile media*, 7(1), 1-30.

Belleflamme , P, Lambert, T & schwienbacher, A. (2014). Crowdfunding: Tapping the right crowd. *Journal of Business Venturing*, 29(5), 585-609.

Brabham, D. C., (2008), Crowdsourcing as a Model for Problem Solving, *The International Journal of Research into New Media Technologies*, 14, 75-90. doi: 10.1177/1354856507084420

Gligoric, N., Uzelac, A., & Krco, S. (2012). Smart Classroom: Real-time feedback on lecture quality. In Pervasive Computing and Communications Workshops (PERCOM Workshops), 2012 *IEEE International Conference*, 391–394. IEEE.

Howe, J. (2006), The rise of crowdsourcing. Retrieved 2. February, 2016, from http://archive.wired.com/wired/archive/14.06/crowds.html

Jones, B. L., (2008), Web 2.0 Heroes, Interviews with 20 Web 2.0 Influencers, *Wiley Publishing*, vol. 1, 288.

Kuppuswamy, V., & Bayus, B. L., (2015), Crowdfunding creative ideas: The dynamics of project backers in Kickstarter, UNC Kenan-Flagler Research Paper No. 2013-15.

Llorente, R.,Morant, M. & Garrigos-Simon, F. J., (2015) Crowdlearning, Applying Social Collaboration in Higher Education, *International Conference New perspective in Science Education*, vol4, pp.256-260

Mollick, E., (2014), The dynamics of crowdfunding: An exploratory study, *Journal of Business Venturing*, vol. 29, 1-16.

Poetz, M. & Schreier M., (2012) The value of crowdsourcing: can users really compete with professionals in generating new product ideas?*Journal of Product Innovation Managment*, vol. 29

Sclater, N., (2006.) Moodle: Transforming Learning Transforming Institutions in Moodle, *Regional User Group Conference*, London: Packt Publishing 64

Statistics on Kickstarter (2016). Retrieved 27. February, 2016, from https://www.kickstarter.com/help/stats?ref=footer

ILS LEARNING STYLE MODEL AND MULTIMEDIA E-LEARNING

Vitomir Radosavljević*[1], Danica Mamula Tartalja[1], Gordana Jelić[1]
[1]ICT College of Vocational Studies in Belgrade, Serbia
*Corresponding author, e-mail: vitomir.radosavljevic@ict.edu.rs

Abstract: *Contemporary trends in education are heading towards the learner-adapted education. Some research issues dealing with adaptive forms of education refer to the establishment of efficient adaptation criteria. This paper presents the results of the research aimed at identifying the correlation between the students'learning styles, based on Felder-Silverman ILS learning model, and multimedia e-learning styles. The research was carried out in October 2015, at the ICT College in a sample of 64 students. The results showed that currently no correlation can be identified between the learning style according to the ILS model and any of the four types of multimedia e-learning. Furthermore, the research pointed out the tendency of some students towards specific forms of multimedia e-learning. These conclusions can be used as the basis for the definition of criteria and the development of adaptive learning.*

Keywords*: learning styles, adaptive learning, multimedia e-learning, e-learning*

1. INTRODUCTION

The process of education and self-improvement is considered to be one of the basic elements in the society and represents the foundation of social prosperity and development. Consequently, the approaches which will ensure the efficient and effective educational process have been intensively developed. Contemporary trends in education are heading towards the learner-adapted education. The education process is adapted to meet the requirements and habits of a learner. It must be designed to best use the characteristics of a learner which are relevant for the learning process, to motivate the learner and to ensure the long-lasting retention of acquired knowledge.

Following the trends in education, the research was carried out at the ICT College in Belgrade, in October 2015, with the aim to consider the opportunity of introducing the adaptive forms of education into the teaching process. The ultimate objective of the research is the integration of multimedia e-learning styles into certain courses according to suitable adaptation criteria. This paper presents the results of the research aimed at identifying the correlation between the students' learning styles, based on Felder-Silverman ILS learning model and multimedia e-learning styles.

This paper is divided into several sections. After the Introduction, Section 2 presents the theoretical framework as the basis for the research. In Section 3, both the research and the research results are presented and analysed. The conclusions are given in the last section.

2. ADAPTIVE EDUCATION

Learning is a set of constructive processes which a person uses to activate himself, individually or in a society, and to elaborate, build and organize knowledge. On the basis of experiences and knowledge acquired through the learning process, a person's behaviour has undergone some permanent changes and thus his approaches towards situations are also changed. According to Vulfolk, Hujuz adn Volkap (2014) factors which affect the learning outcomes can be grouped into seven categories.

- Intellectual factors. The intelligence level is not universal for all segments of knowledge. This accounts for the fact some students acquire high grades in one field compared to lower success in acquisition of other fields of science.
- Learning factors. These factors are described through the correlation of knowledge and skills a learner acquires. Former bad knowledge in a specific field brings about the troubles in acquisition of new knowledge.
- Physical factors. Physical conditions such as disability and fatigue affect learning and acquisition.
- Mental factors. Mental fatigue and mental flaws also affect the learning efficiency.
- Emotional and social factors such as current mood, relationship with other participants in the classroom, motivation for learning, attitude towards the study topic, are only some manifestations of these factors.

- Teacher's personality and his/her approach towards a learner affect the attitude the individual has to the learning material, and the learning process. The teacher leads the learner through the studying process, and provides support, assistance and the feedback.
- Environment. Environment may be encouraging for the learner. Well-equipped environment in which a learner can without difficulties realize his objectives in the learning process has a positive influence on learning.

The way a person studies varies from person to person. Each individual has his/her own unique way of learning and uses different methods and techniques of gathering knowledge and processing the data he/she wants to learn. The way a learner studies describes his learning style. Learning style is commonly described as a learning strategy.

According to Felder and Silverman (1996) ILS (Index of Learning Style) model there are four dimensions, each containing two categories which define learning styles:
- information processing dimension with categories of active and reflective learners,
- information perception dimension with categories of sensing and intuitive learners,
- information repetition dimension with categories of visual and verbal learners,
- information understanding dimension with categories of global and sequential learners.

Information processing dimension includes two categories of learners. One category comprises learners who learn best through practical examples which apply the knowledge they must learn (Reflective learners). The other category includes Active learners who require an active participation in the learning process. Reflective learners gather and analyse knowledge before taking any actions. They are more prone to observe the work of other learners than to set themselves to some action.

Information perception dimension defines learners described as sensing and intuitive. Sensors are patient, good at memorizing facts and doing laboratory work. They like to solve problems by using pre-defined methods, they do not like complicated comparisons and unpredictable situations. Intuitive learners are better at accepting new concepts and more comfortable with abstractions. They like innovations and do not like contents and actions to be repeated. Sensors are more practical and more cautious than intuitive learners who are faster in work. The difference in approach to the lessons is reflected in additional materials which were "at hand" to sensors, while the intuitive learners' lesson contents were enriched with formulas and block diagrams.

The information reception dimension describes both visual and verbal learners. The former retains the subject matter through photographs, diagrams, maps and demonstrations that should be learned, while the latter memorizes through written text and verbal production.

Information understanding dimension describes sequential and global learners. Sequential learners follow the course section by section in linear way while global learners often skip parts of lessons and refer directly to the materials they find complex without too long pondering over simpler contents.

According to Hamada (2012) and Hwang (2014) learning style can be used as a criterion of learning process adaptation. Adaptive approach is realized through adjusting of particular elements of educational process to pre-defined criteria.The criteria that are set result from individual features of learners, level of motivation, learners' fatigue, features of working environment, instruction materials used in learning process. The most often used criteria in the research of adaptive educational environments are the level of learners' motivation, psychological personality traits, learners' interests, physical state of fatigue of students at a given moment, the style used by a student in the learning process. Adaptive environment for learning should be designed so as to recognize relevant information and to adapt, by using appropriate criteria, the learning process to learner's needs. The changes introduced by the system to adapt the learning process to a student can be of either statistical or dynamic type. Static changes are unchangeable over time and are defined at the beginning of educational process. The dynamic changes modify the educational process over time and constantly adapt it to a learner.

2.1. MULTIMEDIA E-LEARNING

Eysink et al. (2009.) describe multimedia e-learning as the type of learning that uses different sources of information of both visual and auditory type aimed at better understanding and easier retention of the contents to be acquired. Visual content represents video content, photographs, illustrations and graphs while auditory content includes sound recordings, printed or produced words. It is possible to observe 4 types of

multimedia e-learning: hypermedia e-learning, observational e-learning, self-explanation based e-learning, inquiry e-learning.

Hypermedia e-learning represents computer-based environment in which the multimedia contents such as pictures, animations and videos are kept in certain system nodes interconnected and accessed by hyperlinks. The multimedia components offer information through different text forms and photographs that are used to address other auditory and visual contents carrying information. Learners alone decide which information they wish to follow or ignore. The learning pace is individual and the sequence of pieces of information to be followed is determined by the learner. Hypermedia e-learning provides high level of interactivity between the students and the system and offers students high control of the e-learning process. As much as the e-learning process control is positive, it still has some negative aspects. The most important is that students alone should assess the relevance of information he/she gathers which in case of inexperience in the studied field can lead to flaws in learning.

In order to implement successfully this type of studying, a learner should recognize knowledge and skills he/she would like to acquire. A learner expects the outer support in this way of e-learning through leading in the selection of materials for studying and providing appropriate control of access to the contents depending on previous knowledge possessed by the learner.
The knowledge available to a student is represented in different forms. To enable an adequate approach to such information, the student is required to identify the missing knowledge. Information received from the e-learning system must be harmonized with the previous learner's knowledge and presented adequately so as to enable students to detect the missing knowledge. Only then, the learner can focus on obtaining of desired information, planning the search for them, reviewing on the available data in order to reach the desired information and finally to take actions to retrieve the desired data. The last step is verification of the conclusions.

Observational e-learning is a type of e-learning that occurs through observing of others while performing tasks or solving problems. The learner observes an expert, envisages and tries to adopt the applied process to perform a task. The observational e-learning implies also activities from the cognition domain. This type of e-learning implies engagement of an expert who explains process of reflection to a learner, which leads to drawing of certain conclusions, as well as a series of additional explanations including the reason why and when a certain strategy is to be applied. Through this type of e-learning students can practice tasks through mental reconstructions of previous problems and tasks. In computer environment the experts who present knowledge can be real life experts or animated personalities. The disadvantage of this type of e-learning is that learners are passive observers and do not participate actively in construction of mental models of knowledge they receive. Additionally, learners do not possess knowledge on the relevance of information in perceptually rich environment.Outer factors that can positively affect this type of e-learning refer to the increase of motivation with students.

In multimedia environment, most often used are animations or video material that describe which knowledge should be acquired. In case of problem solution the animation contains steps that lead to a solution. A student watches and follows the animation, verifies the steps of animations and listens or reads why a certain problem is solved in the presented way. Upon the completion of the animation, a student should analyse it and repeat an exercise in order to integrate the procedure and conclusions in the mental picture.

Self-explanation based e-learning relies on learning by example and self-explanation. By worked out examples a student is presented a problem that hides knowledge that a student should acquire. Through examples presented to a learner, a problem to be solved is formulated, principles for its solving are introduced together with the steps which lead to a solution and to a final problem solving. Teaching is not stopped on one sole example, but a student is introduced a series of worked out examples. It is thought that this learning approach is very effective because the learners can direct their cognitive potentials to problem understanding and not to searching for accurate solution. This way a learner is stimulated to explain to him/herself the process of reaching the solution and the solution itself. The learners who actively participate in the process of self-explanation based e-learning learn more than the students who do not take part in the process.

In multimedia environment, a learner reads, watches and filtrates information available to him and perceives the steps that lead to solution of the subject problem. In the course of work a learner is asked questions that explain how she/he perceives and understands the steps that are presented as solution. That way learners are stimulated to think about concepts and causal relations behind the procedure that is presented and that way he/she creates a mental picture and fills in his/her knowledge gaps.

Inquiry e-learning is defined as a learning process in which students state their own experiences with the respective subject. A student reveals concepts and features that refer to the subject matter of learning placing the subject in the experimental environment. Based on such data students draw conclusions. The process of learning consists of several phases: orienting, generating hypotheses, experimenting and drawing of conclusions. Due to insufficiently correct performance of an experiment, wrong conclusions can be drawn and incorrect hypotheses can be accepted.
In order to implement an appropriate experiment, a learner must rely to his/her previous knowledge related to the investigated subject matter. Based on previous knowledge, learners form hypotheses, as well as plans on how to examine and test such hypotheses. By comparing the results of different experiments a mental image of knowledge is generated which has to fit into previous knowledge. If it turns out that additional data are needed to complete the mental image, new experiments are to be implemented.

3. RESEARCH DESCRIPTION

The described theoretical concepts served as a basis for implementing the research aimed at examining whether learners who prefer particular learning style more often choose some of the four types of multimedia e-learning. The aim of the research was to establish connection of the learning style and selection of an appropriate type of multimedia e-learning.
The research was performed at the ICT College of Vocational Studies in Belgrade in October 2015. An overall of 66 second-year students participated in the study. They completed a 25-item questionnaire. The application used was Survey at the social network Facebook.

The questionnaire was organized in three parts. The first one included the questions regarding age and gender of the respondents as well as personal assessment of the computer literacy level. The second part encompassed the questions of the standardized Felder-Silverman LSQ. The standardized questionnaire according to the ILS model has 40 items. According to the research in 2007 the key questionnaire items were selected based on which it is possible to optimize the number of questionnaire items. So only 16 items were used to establish learning style according to the ILS model.The last part encompassed the questions in which the respondents could choose a type of multimedia e-learning according to the situation described in the question.

The answers obtained in the study were subject to statistical data processing and consequently the conclusions were drawn.

4. RESEARCH RESULTS

Based on the results obtained in the research it was not possible to establish correlation between the learning style according to the ILS model and forms of multimedia e-learning. This conclusion should be taken questioned to some extent. The sample of 66 respondents provided certain conclusions, but they could not be efficiently confirmed statistically. Due to specificity of the researched field and great number of categories that are statistically processed it is necessary to include larger sample in order to reliably accept or reject the initial assumptions of the research.

The software tool used for data processing was SPSS (Statistical Package for the Social Sciences). The descriptive statistics was used with cross-tabulation option of Chi-test. Based on the second part of the questionnaire, a profile of the learning style according to the ILS model was designed for each individual respondent. These answers were compared with the response to the questionnaire item “In your opinion, which is the most efficient way to understand and acquire certain knowledge?”.The four options of the answer to these questions were in correlation with the respective form of multimedia e-learning. These were the offered options:

- Reading of as many books and linked materials from the field to be learned (hypermedia e-learning)
- Observing experts using knowledge from the field to be dealt with and learned (e-learning by observation)
- Analysing as many examples as possible related to the subject matter (self-explanation based e-learning)
- Work with simulators and testing of simulation from the studied fields (inquiry e-learning).

The following results were obtained:

- Active learners mostly chose inquiry e-learning (13 respondents out of 24 active students opted for this type of e-learning)
- Learners equally described as active and reflective opted least for hypermedia e-learning (only 2 out of 24 students)

- Reflective learners almost equally chose all four forms of multimedia e-learning.
- Sensors chose to the greatest extent hypermedia e-learning (19 of the 42) while intuitive learners mostly chose self-explanation based e-learning (an overall of 7 out of 9 students).
- Visual learners mostly chose inquiry e-learning compared to other types of multimedia e-learning (17 out of 36 students). Learners who are both visual and verbal, as well as the dominantly verbal students equally chose all four forms of e-learning.
- The sequential learners mostly chose hypermedia e-learning (8 out of 22students) and inquiry e-learning (7 students out of 22). The learners who are equally sequential and global dominantly chose inquiry e-learning (13 out of 26) while global learners chose more inquiry e-learning (8 students out of 16).

The above results are presented in the table.

Table 1: Cross-tabulation for all domains of ILS learning according to the multimedia forms of e-learning

	Type of e-learning				
	hipermedia e-learning	observational e-learning	self-explanation based e-learning	inquiry e-learning	**Total**
Active	5	2	4	13	24
Active & Reflective	2	6	7	9	24
Reflective	5	2	3	6	16
Total	**12**	**10**	**14**	**28**	**64**
Sensing	7	9	7	19	42
Sensing & Intuitive	4	0	3	6	13
Intuitive	1	1	4	3	9
Total	**12**	**10**	**14**	**28**	**64**
Visual	8	3	4	7	22
Visual & Verbal	1	4	8	13	26
Verba	3	3	2	8	16
Total	**12**	**10**	**14**	**28**	**64**
Sequental	5	6	8	17	36
Sequental & Global	4	3	3	7	17
Global	3	1	3	4	11
Total	**12**	**10**	**14**	**28**	**64**

5. CONCLUSION

The implemented research provided important guidelines in the field of adaptive and multimedia e-learning. Although no statistically significant difference between the ILS model and multimedia forms of e-learning has been confirmed the authors' stance is that this attitude should be additionally researched. This type of research requires larger sample to obtain statistically significant conclusions. Nevertheless, the importance of this research is reflected in the results that indicate that there are grounds to support claims that certain dimensions pertaining to ILS model can be correlated with the choice of an appropriate form of multimedia e-learning. So, inquiry e-learning was mostly chosen by active, visual and global learners. Hypermedia e-learning was chosen by sensing and reflective learners, self-explanation based e-learning was chosen by the intuitive learners while observational e-learning was chosen by both visual and sensing learners. These stances should be additionally corroborated by the research that would take into account more respondents and consequently provide a statistical confirmation of the said assertions.

REFERENCES

Barać, D., Bogdanović, Z., Milić, A., Jovanić, B., Radenković, B., (2011). Developing adaptive e-learning portal in higher education, *TVC 2011 Proceedings on CD, Alicante, Spain*, 128-135. ISBN: 978-88904327-1-2.

Despotović-Zrakić, M., Simić, K., Labus, A., Milić, A., Jovanić, B., (2013). Scaffolding Environment for Adaptive E-learning through Cloud Computing, *Educational Technology & Society, 16 (3)*, 301–314. ISSN: 1436-4522, 2013

Eysink, T.H.S, De Jong, T., Berthold, K., Kolloffel, B., Opfermann, M., Wouters, (2009). Learner Performance in Multimedia Learning Arrangements: An analysis across Instructional Approaches, *American Educational Research Journal, Vol. 46, No. 4*, 1107-1149.

Felder, R.M, Soloman, B.A, (2009). Retrieved from.http://www.engr.ncsu.edu/learningstyles/ilsweb.html

Graf, S., Viola, S.R., Leo, T., (2007). In-depth analysis of the Felder-Silverman learning style dimensions, *Research on Technology in Education, 40(1).*

Hamada, M., (2012).Learning style model for e-learning systems. Active Media Technology, *Lecture Notes in Computer Science Volume 1*

Hwang, G, (2014). Definition, framework and research issues of smart learning environments - a context-aware ubiquitous learning perspective, *Smart learning enviroments 2014* 1:4. doi:10.1186/s40561-014-0004-5

Jih, H.J., Reeves, T.C., (1992). Mental Models: A Research Focus for Interactive LearningSystems, *Educational Technology Research and Development, Vol. 40, No. 3*, 39-53.

Kim, J., Lee, A., Ruy, H., (2013). Personality and its effects on learning performance: Design guidelinesfor an adaptive e-learning system based on a user model, *International Journal of Industrial Ergonomics Volume 43, Issue 5*, 450–461.

Koper, R., (2014). Conditions for effective smart learning environments, *Smart learning enviroments 2014*, 1:5. doi:10.1186/s40561-014-0005-4, 2014.

Leman, I. (2008), *Motivation.* Deutscher Taschenbuch Verlag

Marković, N., Jovanović, N., (2012). Learning style as a factor which affects the quality of e-learning,*ArtifIntell Rev 38,* 303–312.

Radosavljević, V.,Jelić, G., Štrbac, S. (2015.) Motivation and Personality model as a representative factor of students studying habits. *The Sixth International Conference on e-Learning (eLearning-2015) Belgrade, Serbia*, 154-158.

Ryan, R.M., Deci, E.L., (2000). Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions, *Contemporary Educational Psychology 25,* 54–67.

Savić, A., Radosavljević, V., Slavković, N. (2015) Improving the resting state efficiency of e-learning process by using web content*, IIER 8th International Conference on Science, Innovation and Management (ICSIM), Saint Petersburg, Russian Federation,* 54-57.

Shneiderman, B., Plaisant, C. (2005), *Designing the user Interface.* Pearson Education, Inc

Vulfolk, A., Hujuz, M.,Volkap, V. (2014), *Psihologija u obrazovanju.* Publisher Clio

Woofolf, A, Hughes, M, Walkup, V. (2011).*Psychology in education,* Pearson education, Inc.

CRM MODEL IN E-BUSINESS FOR NON-COMMERCIAL ONLINE RADIO

Nenad Badovinac*[1], Katarina Đorđević[2]
[1]Azelija
[2]Faculty of organizational sciences
*Corresponding author, e-mail: nenad.badovinac@gmail.com

Abstract: *Non-commercial online radio stations require ICT support so they could promote themselves in today's turbulent times. The fact is that listeners don't have time to listen shows that do not belong to their interest group. This paper describes an idea that aims to raise the quality and increase the listening of non-commercial thematic online radio. For this purpose, we used the advantages of the concept of CRM and social media. From broadcasters of the online radio is expected to raise the level of professionalization of the narrator, and broadcast interesting and useful audio content. Worrying about the audience will be job of the CRM system, so that the management of the radio can be 100% focused on the quality of the audio broadcast. Interested listeners will show their satisfaction by giving the recommendations. Feedback on the overall activities of the listener will lead CRM system. CRM model described in this paper will be able to establish two-way communication with the audience: the audience will be divided into interest groups, and the show will be classified in a particular category. Example of CRM system for non-commercial online radio in this work is shown in the case of online radio Blagovesti.*

Key words: *CRM services, online radio, mobile applications, online surveys*

1. INTRODUCTION

In the Internet space is difficult to promote non-commercial online radio station. For the purposes of broadcasting, technology most commonly use one-way communication from the emitter to the listener. Electronic media are using modern ICT technologies that use two-way communication model where users can actively manage the content of program. This concept is more applicable for TV media then for the online radio. However, this concept is recommended for non-commercial online radio stations that do not have a budget for marketing. By using modern ICT technologies, it becomes easier to attract potential listeners and give them the opportunity to try the experience of two-way communication. The first step is to publish online surveys, which aims to get the contact information of potential listeners, who are interested in a particular topic. Contact information from the survey are going to be entered in a CRM system, and since then the CRM system takes care of them.

The paper has a detailed description of the CRM model that allows you to manage the relationship between broadcasters and potential listeners. Defined CRM radio model is for themed online radios that have, for example: scientific, historical, cultural, educational, medical or religious programming content. Since this is about non-profit radios, they are heavier visible to potential listeners. After registering and creating a personal profile on the online radio, the listener is identified as a member of the radio. The listener then has to install the mobile app on his smartphone and in that moment was started a two-way communication between broadcaster and listener. The CRM system takes care of the listener, sending him reminders on his mobile app with the time appointment of thematic programs. Listener can recommend online radio to his contacts. When the contact recommendations of satisfied listeners log on the system, CRM module will record and award recommendation.

2. REVIEW OF AVAILABLE SOLUTIONS ON THE WORLD MARKETPLACE

Customer Relationship Management (CRM) is each application or initiative designed to help the organization to interact with users, customers, suppliers or potential customers via one or more points of contact - such as call center, seller, distributor, branch, Web or email - with the intention of retaining or increasing the number of customers (TDWI 2000). CRM is based on the assumption that users are the core of business and the success of any company depends on the effective management relationships with them. Relationship exists if there is "a series of interactive episode between two or more parties over a period of time" (Buttle 2009). In case of our CRM model, whose use is on the online radio, it is clear that the interactions are very common. Using the information collected about users is aimed at increasing their loyalty and satisfaction, and the relationship gets better, longer-lasting and more profitable for companies. The important role of CRM in the

business of electronic media has been recognized in numerous studies. In the (Larose, 2004, 2010), the authors emphasize the importance of analyzing the specific characteristics of the audience, especially their habits. Also, the importance of determining the model of customer behavior in the digital environment is discussed (Webster, 2011). The authors discuss the structure and method of providing content to customers, but also they want to point out that the convergence of media and integration of the best solution.

On the world marketplace there are numerous solutions in our research field, and some of them are: WO Sales, Media, Radio workflow, InfluenceFM Radio Management Software, Salesforce, SalesTouch, Media Sales.

WO Media Sales. [1] This solution stands out as the main benefits:

- *The multi-layered architectures* - in terms of access and control of large organizations that operate on multiple markets with a large number of media.
- *Control of user accounts* - access to customer data, their habits, to create and monitor schedules and plans.
- *Create schedules and plans* - for each station and the market individually.
- *Research* - to easily create detailed reports based on the collected data.
- *Ranking data* - separation of data per significance.
- A clear order of work process: knowledge of listeners, campaign creation, contracting marketing, acceptance of bids, monitoring performance, the acceptance of the final results.

Radio workflow[2].

This CRM system is intended primarily for radio stations. Contributes to reduce costs, increase productivity and income, to implement quality processes, contributes to better communication. In the support of this CRM system is going great number of world famous stations that use it: Virgin Radio, Shore 104.3 FM Classic Rock 101, Zinc 96.1, Hot 91.1 FM.

InfluenceFM[3].

The CRM solution is for radio stations. Some of the functions that allows tracking user activity, obtain notification depending on client activity (cancellation, customer dissatisfaction, etc.), planning the interactive calendar, the integration of Gmail and Outlook calendars, tracking all levels of the sales process, the automatic creation of reports, work on a large number of devices (Windows, iOS, Android).

Media Sales[4].

Comprehensively CRM solution has the following functionality:

- Monitoring of the company, contacts and products
- Work with user accounts
- Create messages and e-mails
- Work with your calendar, plan

Supplied solutions have proven to be very effective in communicating with a large number of users, so it's our conclusion that we should follow the world trends and offered solutions, but also to harmonize the product for our customers and their needs in order to increase the listening of the radio and the listeners happiness.

3. CRM MODEL FOR ONLINE RADIO STATIONS

Announcing the campaign on social nets it is possible to reach the potential listeners, which are interested for thematic online radio stations. By forming the central web portal for presenting non-commercial thematic radio stations, potential listeners will have a chance to choose the thematic radio station depending on their interests, for example: Radio for fishermen, Radio for gourmands, Radio about history or religion.

[1] http://www.wideorbit.com/wideorbit-products/wo-media-sales/
[2] https://www.radioworkflow.com/
[3] https://influence.fm/
[4] http://www.wedelsoft.com/en/mediasales-software/crm-for-media-companies/

When the potential listener has decided for specific thematic online radio, he receives the link for downloading mobile application which he has to install on his cell phone. Mobile application will offer survey questions and corresponding answers will determine the specific group of listeners. CRM system is grouping listeners' profiles in specific groups staggered depending on the level of interest for the specific theme. For example, for a listener who started the online radio for gourmands, there are these specific groups: Mediterranean dishes, Seafood, Mexican specialties, etc. When the specific group of listeners is determined, then the CRM model for announcing listeners' profiles by using pop-up messages on a mobile phone is activated. Messages are related to timetable of categorized programs dedicated to specific internal groups. Every single day, within CRM module, will be created the list of programs for the next day, which will contain a scheme for broadcasting. Like for example:

The list of programs divided in specific groups for the „Radio for gourmands", for the next day will be:

Group MD – Mediterranean dishes: 02h, 05h, 15h
Group SF – Seafood: 18h, 19h
Group MS – Mexican specialties: 20h, 22h

When the mobile application gets this list from the CRM module, it will inform the listener with reminder, half an hour before the program starts.

CRM module subjects are:

- Online radio administrator
- Narrator
- A potential listener
- Listeners

An administrator – of non-commercial online radio organizes professional narrators for the specific subject of that online radio. It confirms and agrees that a specific audio program can be placed on the online radio server by a narrator. The administrator creates 24h program scheme. PHP scripts will do the technical job, put the 24h program on the shout cast server. The administrator follows BI statistics.

Narrators – will produce mp3 files and categorize them in specific categories. Narrators will put the specific prefix in the mp3 file's name by which they will categorize the program, for example: Program about preparing seafood will have the prefix „SF", program about Mediterranean kitchen will have prefix „MK", and etc.

A potential listener – potential listeners are contacted through social media. They have a choice of one of offered non-commercial thematic online radio stations. After registration, they are downloading smartphone application and are becoming active listeners, members of online radio. They are becoming the part of CRM system.

Listeners – are registered radio members which have a possibility to listen to the radio program, but also to be informed on time about interesting programs next day. They also have a possibility to recommend non-commercial online radio to their contacts and use the possibility to take a part in a radio program as loyalty members.

CRM system guides the listeners' profiles (groups with different interests) and audio program (categories). It will create relationships between the program and a listener. The information about the belonging of a listener to a specific group will allow the CRM system to inform a listener at the time (30 mins before the program starts) by the pop-up message on his mobile that the program from his group of interest will start soon. Statistics will be notifying the number of listeners and will be informing him about eventual need for a group change.

3.1. Architecture of a proposed paper

Potential listeners, and listeners

- Fill in the survey when choosing the thematic radio
- Decide which specific non-commercial thematic online radio want to listen
- Register for that radio
- Download smartphone mobile application
- Choose the area of interest – belonging to a specific group of interest

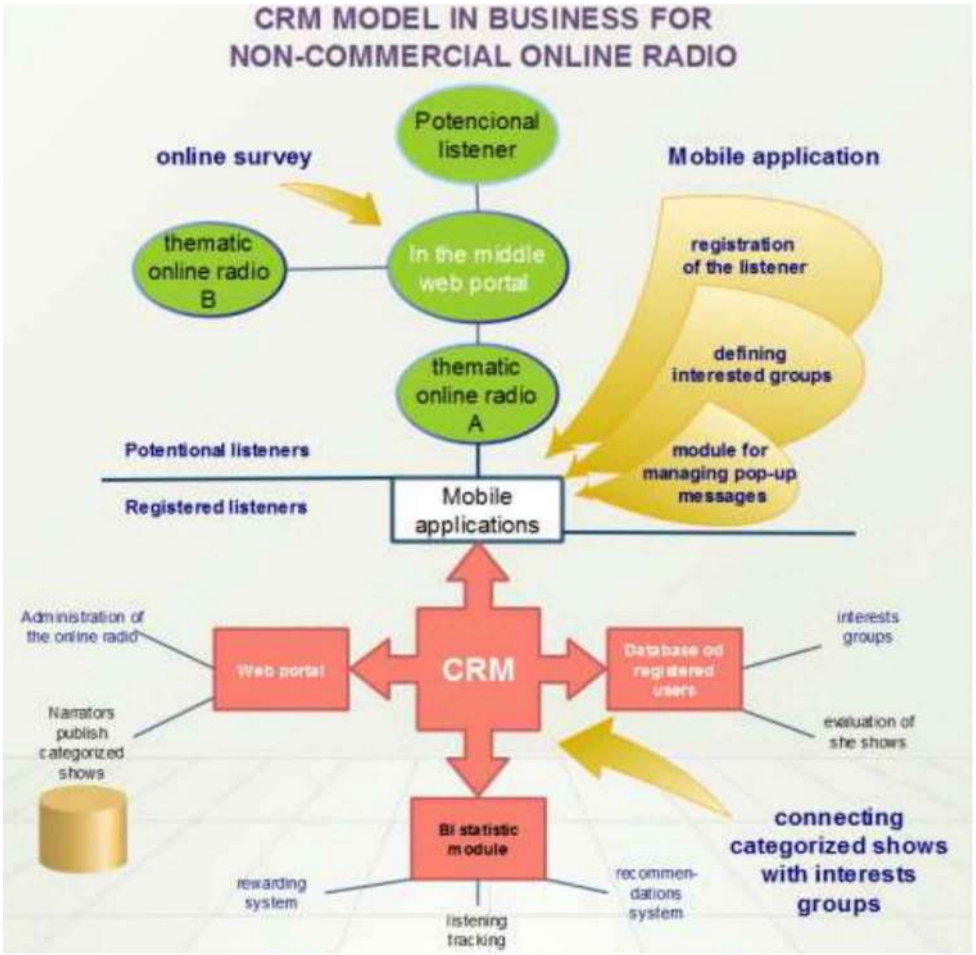


Figure 1. Model of CRM online radio

Mobile application

- Online radio player
- Overview of a program scheme for the current day
- Module for management with a reminder for thematic programs interesting for a listener
- Statistical module measures the listening time and accepts listeners' marks
- Implemented module for managing with recommendations

CRM system

Application layer

- Administrative panel for managing the program scheme
- Narrators categorize a program and using WordPress put them on a Web panel
- CRM module links the programs categorized by narrators with the correct groups of interest
- CRM module informs a mobile application with a registered user's profile with a list of programs that needs a reminder sent to listener and inform him about interesting programs

Data layer

- Database of registered listeners classified in specific groups of interest
- Database of categorized mp3 audio programs

Statistical layer

- Statistical data of the number of listeners
- Statistics recommend an eventual change of a group of interest
- Evidence of recommendations of a registered listeners

4. THE EXAMPLE OF THE IMPLEMENTED CRM ONLINE RADIO

The project of online radio Blagovesti uses advantages of the ICT technology stated in this paper. It is related to a religious theme. Potential listeners have been contacted through social nets, and they have left their profile data by filling in online surveys. CRM has divided them into groups of interest. The radio administrator sends some thematic texts to narrators. They read them, categorize them into specific categories and put them on the web portal made in WordPress.

During the next day, narrators are putting audio programs on the web page. At the end of the day the radio administrator puts the program scheme for the next day. PHP script that implements the program for the next day is automatically activated at midnight.

When the PHP script is done, CRM system has the access to the data with the list of categories of programs which will be downloaded by mobile applications. For example, categories: programs with spiritual messages will be broadcasted at 01h, 03h, 07h, 09h, category Reportage will be broadcasted at 02h, 15h, 18h, category Program about the history of the Church at 17h, 19h, category Programs about health at 22h, 23h. Regarding statistical data, the average number of listeners (IP addresses) connected to the online radio Blagovesti is approximately 40, i.e. 80 listeners constantly. They usually spend approximately 180mins on the radio what implies that approximately 800 listeners access the online radio.

Figure 2. Web site

On the web portal of the radio Blagovesti, there is a program scheme for the next day on the right-hand side, and in the middle, broadcasts are placed by narrators. Programs are available for off-line listening, which means that all of them can be listened by choosing the web page or by downloading it in the mp3 format. Reproduction of the program starts automatically by accessing the web page. A player as a WordPress plug-in is incorporated in the web page.

Mobile application: A dedicated Mobile application "Radio Blagovesti 2.0" has been created and it serves as a player for online radio Blagovesti, but also for the two-way communication between CRM system and a listener. By using a mobile application, a listener is defining his interests, and the CRM system contacts the application about the lists of the programs dedicated to a group of interest to which a user's profile of a mobile application belongs.

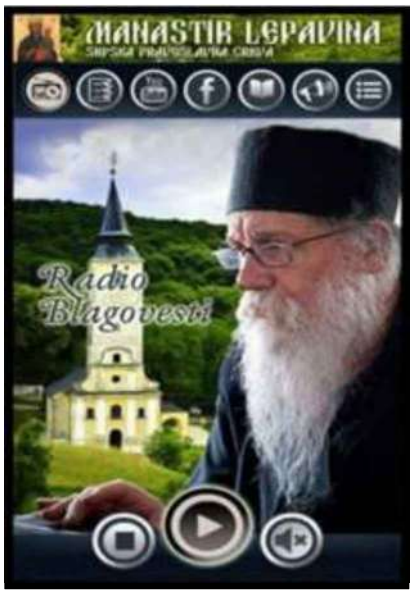


Figure 3. Mobile application
"Radio Blagovesti 2.0"

Mobile application has several functions:

- Audio player
- An overview of the radio broadcasting scheme
- Access to the administrative Facebook page
- Access to the YouTube canal
- Archiving of the web links of audio programs which belong to the listeners' group of interest
- CRM functionality: incorporated reminder system
- CRM functionality: accesses users' profile data
- CRM functionality: defines and changes listeners' groups of interest
- CRM functionality: manages recommendations

5. CONCLUSION AND DISCUSSIONS

By using CRM functionalities thematic non-commercial online radio stations could easily reach their listeners and make a two-way communication with them, which is important nowadays when a listener wants a better quality service. Listeners do not have time to listen non-commercial radio program the whole day, and it is needed to be in touch with a listener and inform him about the programs which he specified in the survey as interesting. A mobile application will archive web links of those programs which are of exceptional importance for a listener's group of interest. This way we respect our listeners' time and take care of them.

REFERENCES

Buttle,F (2009). Customer Relationship Management, Burlington, MA:Elsevier

Iftikhar Ahmad, Ataur Rahman Chowdhury (2008). Electronic Customer Relationship Management (E-CRM)

LaRose, R., & Eastin, M. S. (2004). A social cognitive theory of Internet uses and gratifications: Toward a new model of media attendance. Journal of Broadcasting and Electronic Media, 48, 358–377.

LaRose, R. (2010). The Problem of Media Habits. Communication Theory, 20(2),194–222, doi:10.1111/j.1468-2885.2010.01360.x.

TDWI On site Education (2006). World-Class Business Intelligence and Data Warehousing Education in Your Environment

Vanjica Ratković-Živanović, Dušan Barać, Ivanka Kovačević (2010). Providing CRM services in B2B portal of electronic media

Webster, J. G. (2011). The Duality of Media: A Structurational Theory of Public Attention. Communication Theory.21(1), 43-66.

WEB SITE INTEGRATION INTO ORGANAIZATIONAL STRUCTURE OF THE LOCAL TOURIST COMMUNITY

Jelena Vasković[*1] Miloš Bačević[1]
[1]Belgrade University, Faculty of Organizational Science

Abstract: *In the operations of the local tourist community, Web site represents a central place where visitors can be informed. Based on the impressions they have gained there, their decision whether to visit the destination or not will be made. Since site is significant for business, two elements should be defined: site integration into the organizational structure of the local tourist community and methodology for evaluating the quality of the site, as well as its success in the business environment. The paper proposes a model of Web site integration and defines the methodology for its quality evaluation. Evaluation of the site has always been problematic because there is a large number of subjective factors that affect its quality. In this paper, Elements of Quality of Service (QoS) are separated from Quality of Experience (QoE) in addition to the analysis of other criteria. Thus separated Methodolog of evaluation, provides the opportunity to mesure quality of website more precisely.*

Keywords*: site integration model, site evaluation, local tourist community*

1. INTRODUCTION

In modern environment, the existence of local tourist community without a well-conceived Web site is almost impossible. First of all, it is necessary to present, in one place, local tourist community, as well as to display all options for informing visitors. Marketing and promotion of local tourist community is business which has to be organized with an aim of presenting the offer in the best way. Also, it is a place where local service providers (hotels, motels, apartments, caterers and others) should set their links, so visitors can find all relevant information in one place. Individual facilities generally have modest Web sites without additional options such as payment services or loyalty schemes and it is in their best interest to connect with the environment, so they can use those additional features. Local tourist community website should be a portal, where all local service providers can connect and get advanced features and services. They can achieve this by placing their link on the site of the local tourism community. By using a website, local tourist community acts as a single unit with unified offer of all services relevant for visitors with a main goal to promote all its associated members engaged in providing tourist services and place them in an equal position.

2. LOCAL TOURIST COMMUNITY WEB SITE

Website of the local tourist community is a part of system and its task is to integrate several elements of the tourist offer, as well as to deliver information to the customers-tourists and to be one of the focal points of their connection with the environment. In order for the Website to function, it must be intensively supported by the local administration, which means that part of the services must be involved in the development, implementation and maintenance. Base initiative must be generated at the local level, and someone has to fund the initial development of the website, define the basic concept requirements and do the initial version of the site. It is possible to assign the site development to local experts employed in the local administration, but in most cases, to outsource these jobs.

In order for Website to function, it is necessary to form the background department whose task is to prepare materials that will be shown on the Website. This is a serious and thorough work which has to be constantly harmonized with the management of the local tourist community. It implies that rules for the preparation and approval of the materials that will be shown on the site must be agreed between the background departments and local tourist community. Control over this process should not be given to employees in background department, because materials prepared in such a way may conflict with the decisions and policies of the local tourist community and because it is not advisable to deny previously published information. Site is a public way to communicate, so any published information has to be confirmed as valid and has to be in accordance with the interests of the entire community. This means that all materials prepared by background department have to be present to relevant persons in local tourist community, and only after obtaining their consent, be published on the Website.

In order for a Website to function in unity with the environment, it is necessary to connect it with environment so that booking system, payment system and loyalty scheme could be involved in the business. This connection is established through a background department (back server), because the part of the local

booking systems that apply only to the local community can be serviced locally, but if you need to include payment systems or loyalty schemes, then there must be a connection with these systems. (Daglas, P (2015)).

The second set of information that should be collected and refer to local tourist community are information collected from sensor networks. Placement, collection and distribution of information such as air and water temperature, humidity, pollen, parking places in the city, etc. is usually made within the information systems of the local tourist community (Smart city), but their processing and distribution is made through the website. This further means that collected information should be analyzed and prepared for posting on a website. These data can be made available through other channels too, but it is required that they be placed in order to have all information in one place.

Data collected in this way can be used to prepare the proposals for tourists and suggest them what to do on particular day. Based on the weather forecast (sunny, cold, windy) it is possible to suggest visiting places of interest, or to offer to organize entertainment events. Website or background department that receives and distributes information, should be a central place for organizing offers for events to be held at particular destination. Relevant information may also contain suggestions on to what to do in certain cases (where to go if it is raining).

The third set of the information are articles, pictures and multimedia materials that should be available on the site. This is something that is dealt by journalists, photographers and staff responsible for multimedia presentations. This kind of work should be delegated to marketing and branding sector of local tourist community. It implies linking all facilities that have their own separate sites and integrating them vertically into existing infrastructure.

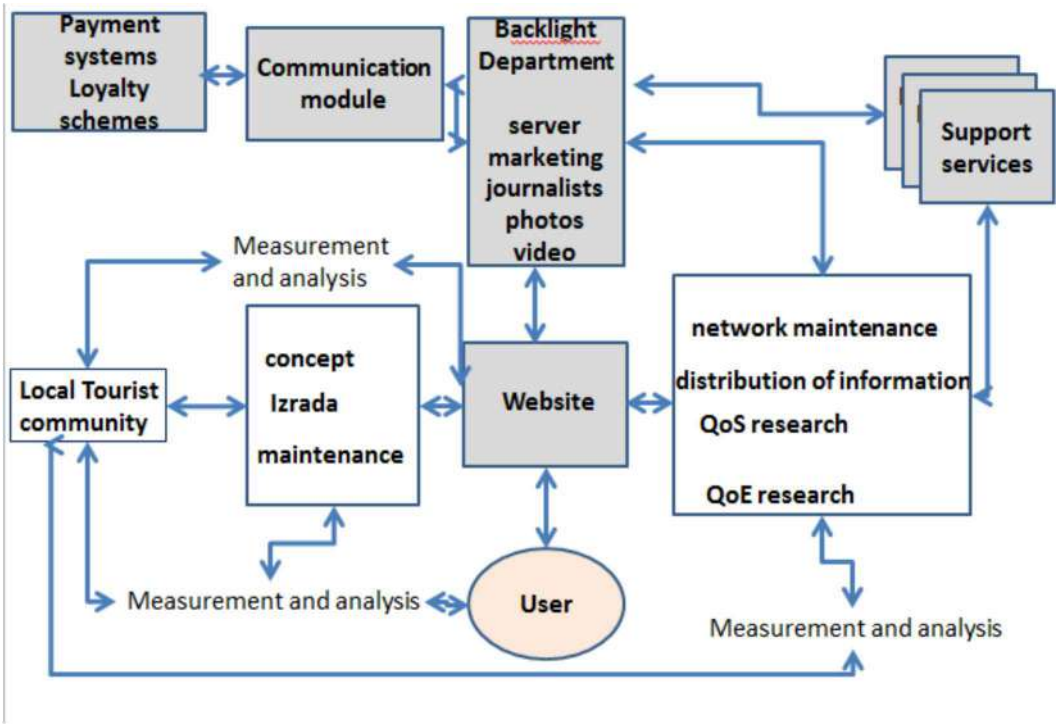


Figure 1: Model integration site into the structure of the local tourist community

In order for site to successfully perform its function, it has to be well organized so that information can be easily found. This especially applies to accommodation at the relevant destination, and offered entertainment events, which should all be supported with pictures. Pictures should be large and well-chosen in order to have an emotional impact on visitors. Pictures can say a lot more than the text so they should be chosen with special care, because their main goal is to awaken the desire to visit the destination. Besides pictures, video materials are something that can significantly complement the emotional involvement of users, particularly if they are accompanied by appropriate music and well prepared text (spoken and written). It is important to display guests at particular destinations in pictures and video materials, because it increases the emotional experience and potential tourists desire to visit the destination. Special attention should be paid to the segment of population that the site is intended for. Before the preparation of the material, detailed analyses should be made of visitors' habits, preferences and experiences. This further implies that there

should be a specialized sector within the local tourist community conducting research work on who the visitors are. Significant part of these information can be collected using social networks, based on the information which users themselves place. By following this information and by direct contact, users can be motivated to share their positive experience with local tourist community which, at the same time would gain insight into what should be done in order to improve the offer. Simple and elegant design of the site which includes maps, hints and tips on what to do and how to spend the time at chosen destination, significantly enhances operations of the local tourist community. (Buhalis, D., & Lawb, R. (2008)).

On the other hand, a large number of questions and requests ca be expected from the users. This means that some of the answers can be found in the "frequently asked questions" part of the site, but they should also have at their disposal "Call Center", phone or agency for any additional questions or problems solving.

Site means continuous work and in order for it to function in accordance with the business environment, it is necessary to have a methodology to evaluate its effectiveness and quality.

3. WEB SITE QUALITY EVALUATION OF THE LOCAL TOURIST COMMUNITY

Since the appearance of Internet, there is a constant need to evaluate sites and to measure their quality. Problems that occur in these estimates are primarily in the complexity of the criteria and the specifics of the web sites impact in different business environments. This further means that sites in certain industries can be quite satisfactory and same concept in others does not give good results. Web site is a place of communication with users. In order to allow evaluation of their quality, different methodologies have been used. (Malak, G., Bader, L (2004)).

In order to enable a comprehensive evaluation of the sites quality it is necessary to separate two different views in the methodology, QoS (Quality of Service), which include technical elements of the site quality and the quality of user experience QoE (Quality of Experience).

Quality of Service (QoS-Quality of Service) depends primarily on the technical capabilities of the network through which users have access. In addition to these limiting parameters, the service quality is also affected by the size of graphics, video materials and all the multimedia elements that require a large amount of transmitted information. Multimedia materials, that are needed on the site significantly increases load of the communication channels, so they are expected to have a large bandwidth, sufficient bit rate where there will not appear delay or packet loss when it comes to the live broadcast. Special category that should be mentioned here is the ability to access the site using different devices. Increased presence of mobile devices and access to Internet services through these devices requires the site to be adjusted in such a way that will ensure its display on these devices. This emphasizes the need to take into consideration communication channels when evaluating the quality of the site. Set of parameters for QoS includes additional services such as social networks, connection with the environment and e-marketing.

On site e-marketing represents an additional load because this includes demanding multimedia presentations, video and audio materials of high quality graphics which significantly loads communication channels.

Since QoS does not consider the quality of network performance from the standpoint of customer perception, QoE (Quality of Experience) concept has been introduced to improve the quality of the customer experience. QoE in this case should serve as a metric to qualify quality of service and network administration from the perspective of customer perception but also to analyze other criteria that make users satisfied. In this case QoE presents a measurement of the quality of the customer's perception. In this way acceptance of the placed materials and services can be identified. Thus, the fundamental difference between the concepts of QoS and QoE is their network relationship so it can be said that the QoE is user-oriented, and QoS network-oriented concept. Of course, these two concepts cannot be seen isolated one from another. (G Sarada P., V. Pallap 2015)

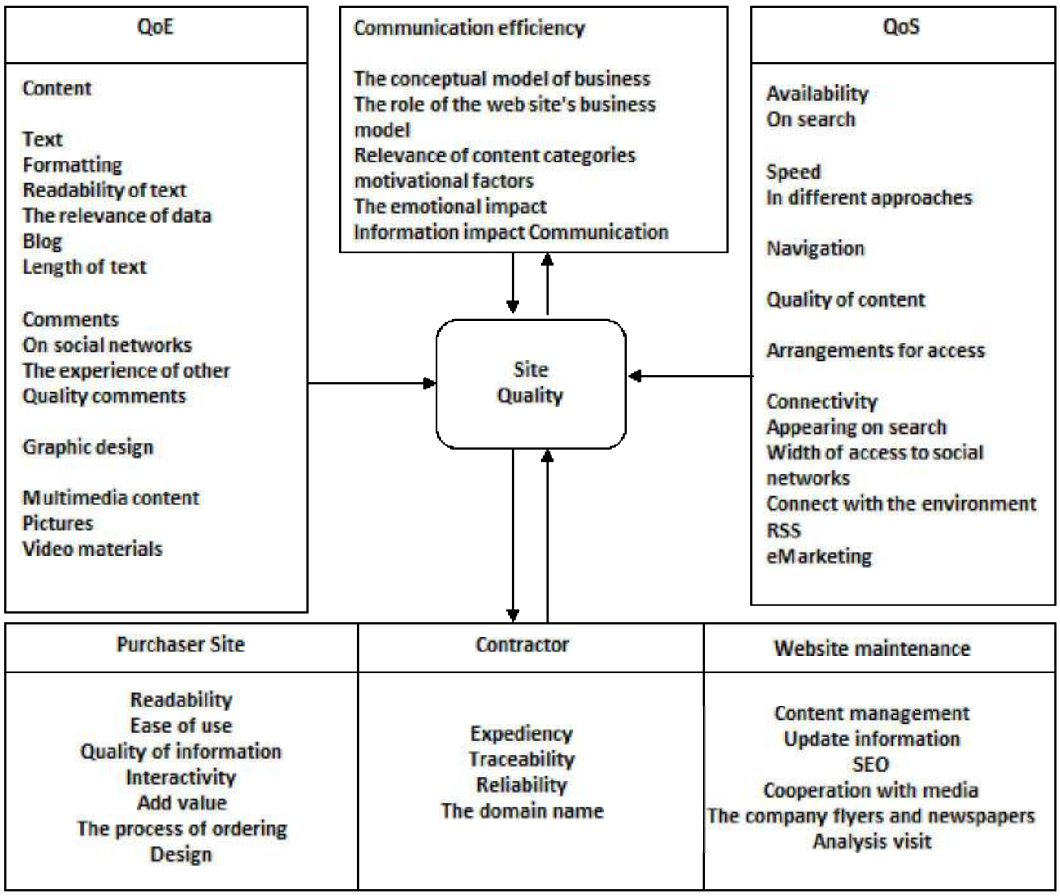


Figure 2: Categories for assessing the quality of the Website

QoE (Quality of Experience) includes a whole range of criteria that significantly affect customer satisfaction. The most important is quality level of graphical design that affects QoE. Well blended color, legible text and appealing design are the basis for high-quality design. Multimedia is almost obligatory part of the site, and it is directly related to QoS. Position of the pictures and all the other visual elements of the site must be easily recognizable and user friendly. All that is shown on the website should focus user on the main goal of website and its offer.

Compatibility is meant to be fully achieved. This means that site is available for different browsers and can work on different operating systems.

The next category which is important for evaluation of the site is communication efficiency. The conceptual model of the company should be primarily analyzed in order to comprehend the role of the Web site in its business model. Business model can include a larger number of categories, for each of them capacity allocation is needed to avoid overlaps. On the other hand, depending on the business model in certain industries (tourism, for example), sites emotional impression on the visitor has a dominant influence. Multimedia content has the special role in this case. The combination of emotion and information creates prerequisites for successful business connections.

Last but also very important category is associated with the development and maintenance of the site. When planning creation of the site, it is necessary to define a set of criteria that the site should achieve. Program requirements should be defined in advance so they can be aligned with main purpose of site and services planned to be implemented. This criteria can be applied only with monitoring of website in long period of time and knowing the organizational structures of development of site. Out of categories available on the site, legibility (the ratio of background colors and letters), the quality of information, additional features and design can be evaluated.

Evaluation of team, that was tasked to create a site, also belongs to this category. Reliability of the site and its stability can be estimated within a long period of observation. The domain name is also very important but even today it is quite difficult to find a suitable free domain.

The specific element of this group is maintenance. This segment can be very well monitored and evaluated since the changes on the site can be easily tracked.

It is significant to note that there are several limitations that such evaluation makes questionable. First of all, all data collected for the evaluation are based on a limited number of access to each site at a particular time, beside the fact that the Web is a highly dynamic and changeable medium. Similar studies in different periods of time can show different results. Evaluation like this will also shed some light on whether there is a divergence or convergence of Web activity over time. If only technical parameters can be evaluated, QoS would be the only parameter that can be measured. Analysis of "log files" is also reliable data and detailed research and comparison can be performed based on this data.

Another problem is the subjective evaluation of the factors and assigning weight coefficients, which introduces subjectivity in this analysis. Interviewing employees can improve the allocation of weight coefficients, because only they know how much individual categories are relevant to their business. Once assigned weight coefficients can be later modified in order to obtain objective research.

4. CONCLUSION

The tourist industry depends on the quality of communication with their visitors. Website, as a central place where visitors can be informed, thus it must meet all their requirements, provides information and also initiate emotions. Website integration into business environment presupposes that the organization has prepared itself. First of all the scheme of preparing material that will be on the site, procedures for compliance and approval of materials that will be posted, must be defined. The website is a public service and for all that is placed on it someone has to be responsible. Technical personnel that maintains website cannot be held responsible, but the responsibility is on the competent management of the local tourist community. There must be a mechanism for coordination and methodology of harmonization in order to avoid conflict. These sites are typically advertising destination or local tourist community and if there is a favoring of certain market participants, conflict of interests must be taken into consideration. The rules must be set, before the commencement of work. Periodic control of quality implies that there is a methodology for evaluation on the ground of which periodic control is made.

REFERENCES

Buhalisa, D., & Lawb, R. (2008). Progress in information technology and tourism management: 20 years. Tourism Management , 29, 609–623.

Cultural Policy Brief Nº 3., (2011). Towards a politics of sustainable tourism. Sustainable tourism: technology and new model Destination Management Systems (DMS). Document established by the Directorate of Culture and Cultural and Natural Heritage, Councile de Europe

Daglas, P. (2014). Toward an Integrative Conceptual Framework of Destinations. Journal of Travel Research. Vol.53(2), 141-153. SAGE Publication, DOI: 10.11.17/ 0047287513491334

Garín-Muñoz, T., & Pérez-Amaral, T. (2010). Internet Usage for Travel and Tourism. The Case of Spain. 21st European Regional ITS Conference, Copenhagen 2010.

Malak, G., Badri, L., Badri, M., Sahraoui, H. (2004): “Towards a Multidimensional Model for Web-Based Applications Quality Assessment“. Proceedings of the 5th International Conference on E-Commerce and Web Technologies EC-Web 2004, Zaragoza, Spain, 316-327.

Miranda, F. J. and Bañegil, T. M. (2004): “Quantitative evaluation of commercial web sites: An empirical study of Spanish firms”. International Journal of Information Management, vol 24, nº 4, August, 313-318.

Miranda, F., J., Cortés, R., and Barriuso, C.(2006): “Quantitative Evaluation of e-Banking Web Sites: an Empirical Study of Spanish Banks”. The Electronic Journal Information Systems Evaluation, Vol. 9, Issue 2, 73-82.

Sarada Prasad Gochhayat, Pallapa Venkataram,(2015) An Efficient Way of Providing Information in Ubiquitous Tourist System, 2015 6th International Conference of Information and Communication Technology for Embedded Systems (IC-ICTES), 978-1-4799-8565-4/15/©2015 IEEE

APPROACH TO COLLABORATIVE MICROLEARNING BASED ON CROWDSOURCING

Anida Zahirović Suhonjić[1], Aleksandra Labus[2], Marijana Despotović-Zrakić[2]
[1] School of business, information technology and market communications "International business-information academy" Tuzla, Bosnia and Herzegovina
[2]Faculty of organizational sciences, University of Belgrade, Serbia

Abstract: *This paper presents integration of crowdsourcing and microlearning in higher education. The goal of this paper is to develop a model of collaborative microlearning based on crowdsourcing. The suggested integrated model can be applied in smart learning environments. The implemented crowdsourcing microlearning project is student-centered and it provides students with opportunity to be both knowledge creators and knowledge users at the same time. The evaluation of results was based on the data collected from survey. The students showed remarkable readiness and interest for participation in collaborative and crowdsourcing projects. Furthermore, it was found that students with higher tendency to participate in crowdsourcing by participating in more crowdsourcing projects have increased intensity of satisfaction and intrinsic motivation. It also influences their perception of the usefulness of crowdsourcing on the dimensions of learning and acquiring skills. On the other hand, the higher tendency for participation in crowdsourcing projects reduces the intensity of perception of reward as extrinsic motivator.*

Keywords*: crowdsourcing, collaborative microlearning, microcourses, creation, attendance, smart learning environment*

1. INTRODUCTION

Development of information and communication technology resulted in different changes in education. It is obvious that the number of classical “face-to-face” lectures was being reduced at universities. At the same time, the level of individual students’ learning is increasing. This type of students’ learning is usually conducted through the use of Internet and must be stimulated with different resources like video materials, individual activities for learning with self-evaluation, etc. (Coccoli, Guercio, Maresca & Staganelli, 2014). The present need to reduce time for learning resulted with development of microlearning and microcourses, and it leads us toward the “micro-era” (Wei, Yang, Zeng & Yu, 2015). There had been changes in the learning styles of students as a result of interactive world around us as well as the increasing popularity of social media which stimulates students to share knowledge in the form of social and collaborative learning (Coccoli et al., 2014). The growing gap between technology and students' motivation for learning (Heusler & Span, 2014) resulted in the necessity for the creation of student-centered educational environment. Smart educational environment accompanied with physical environment enables creation of situations and events necessary for stimulation of individuals to study and find solutions for different problems, to socialize within the group, to exercise and think (Koper, 2014).

As a collaborative model for knowledge creation, crowdsourcing has been used for creating and broadening of knowledge. The examples of using crowdsourcing in the process of education can be found in collaborative projects, supplemental instructions, open educational recourses, public content, peer assessment, problem-based learning and serious games (Anderson, 2011). Development of crowdsourcing has been facilitated by the use of web technologies which help individuals to solve individual, organizational and social problems. Crowdsourcing is characterized by dynamically formed group of people who respond to call from crowdsourcer (Pedersen et al.2013). Further characteristics of crowdsourcing include openness towards the group, participation of a large number of individuals and the use of different platforms (Hosseini et al., 2014). In the process of e-learning, the term crowd is used for describing students. On the other hand, in certain crowdsourcing projects the term can also be used for teachers, alumni, associates, etc. The aim of crowdsourcing is to take an advantage of collaborative work, joint goals and collaboration of students. In higher education, four key models of crowdsourcing can be distinguished: crowdteaching, crowdlearning, crowdfunding and crowdtuition (Llorente & Morant, 2015).

As a new form of education, microlearning can be implemented as a crowdsourcing project in two phases: phase of creation and phase of attendance. Development of online crowdsourcing community fosters collaborative learning. Furthermore, students are in interaction among themselves and with the crowdsourcer. They can create content, share ideas, knowledge and skills, virtual and physical resources, evaluate certain activities and content, vote, etc. Microcourses or microlessons are the forms of online web

video courses which are developed around key points of knowledge (Wei, Yang, Zeng & Yu, 2015). Microlearning shows positive effects on acquiring targeted knowledge and it is adjusted to human attention span (Sun et al., 2015). For that reason, duration of microcourses is usually between 5 and 8 minutes (Wei et al., 2015). Microcourses can be used for online, blended, and face-to-face learning (Hou, Gou & Gao, 2016). Microcourses are primarily based on video materials and they can be formed around the points that can represent problems and difficulties for students at that course (Shen & Shen, 2015). Additionally, microcourses provide students with the opportunity to study anytime and anywhere they want and to adjust learning according to their time (Hou, Gou & Gao, 2016). Social media and specialized platforms can be used to support microlearning. These platforms enable creating, publishing and attending microcourses, among which Coursmos, Daily Bits Of and Grovo are important examples.

Crowdsourcing and microlearning conceptually offer different possibilities and approaches to teaching and learning, but their integration offers the improvement of individual students' work and learning. In this paper we developed a model of crowdsourcing creating and attending microcourses in smart learning environment. In such environment, students are knowledge creators and knowledge users at the same time. The aim is to integrate crowdsourcing into overall process of microlearning. Implementation and evaluation of this project has been conducted at Laboratory for E-business at Faculty of organizational sciences in Belgrade. Evaluation of results indicates significant influence of crowdsourcing mechanisms for creating and attending microcourses on students' satisfaction, perception of acquiring skills, studying and acceptance of the used technology.

2. MODEL OF CROWDSOURCING MICROLEARNING

Integration of crowdsourcing and microlearning in educational process implies design of integral model that will respect performance of existing physical environment, adaptive crowdsourcing mechanisms and readiness for implementation of crowdsourcing collaborative network as a way of upgrading existing e-education.

Microlearning through microcourses can have two dimensions: collaborative learning through creation of microcourses and individual learning through microcourses attendance. Identified crowdsourcing mechanisms in creation of microcourses are: group work, identifying hierarchical/demographic group work, interaction in the group, rewards and relation to crowdsourcer. Within the microcourses attendance the following crowdsourcing mechanisms are significant: comments about content, evaluation, recommendation for others, sharing microcourses on social media, giving recommendations for related microcourses, brainstorming for new topics, rewarding and relation to crowdsourcer.

Adaptive crowdsourcing mechanisms of microlearning have a potential to strengthen participative role of students so that educational environment gains new dimensions and functionalities. Smart learning environment is defined as physical environment enriched with digital, context aware devices in order to advance the process of learning. Such environment has got an educational goal to create productive, smart and responsible members of society (Spector, 2014). In reference to smart environment it can be said that such system should be designed to focus on human and to use all available technologies for sustainability, reliability, mobility and flexibility. Smart solutions should be personalized, adaptive and interactive, and available at any moment, from any place and from any device (Coccoli et al., 2014). In his work, Spector (2014) suggests theoretical framework for conceptualized smart learning environment. It is mostly realized through Internet and Things (IoT) which connects things and devices from real world to the things from virtual world.

Integrated platform for microcourses in smart learning environment should integrate services and applications of crowdsourcing platform, mobile applications, social media and IoT platform (Figure 1). Integrated system should have the following characteristics: availability, adaptability, interoperability, reliability, and possibility of reuse.

The users of integrated platform for microcourses in smart learning environment are students, professors and crowdsourcer. The users can access the platform from different devices like smartphones, tablets, laptops and applications for such devices. The two main ways to access the platform is through web and mobile application. The users can access directly to integrated platform for microlearning or through certain parts of the system (e.g. social media or IoT platform).

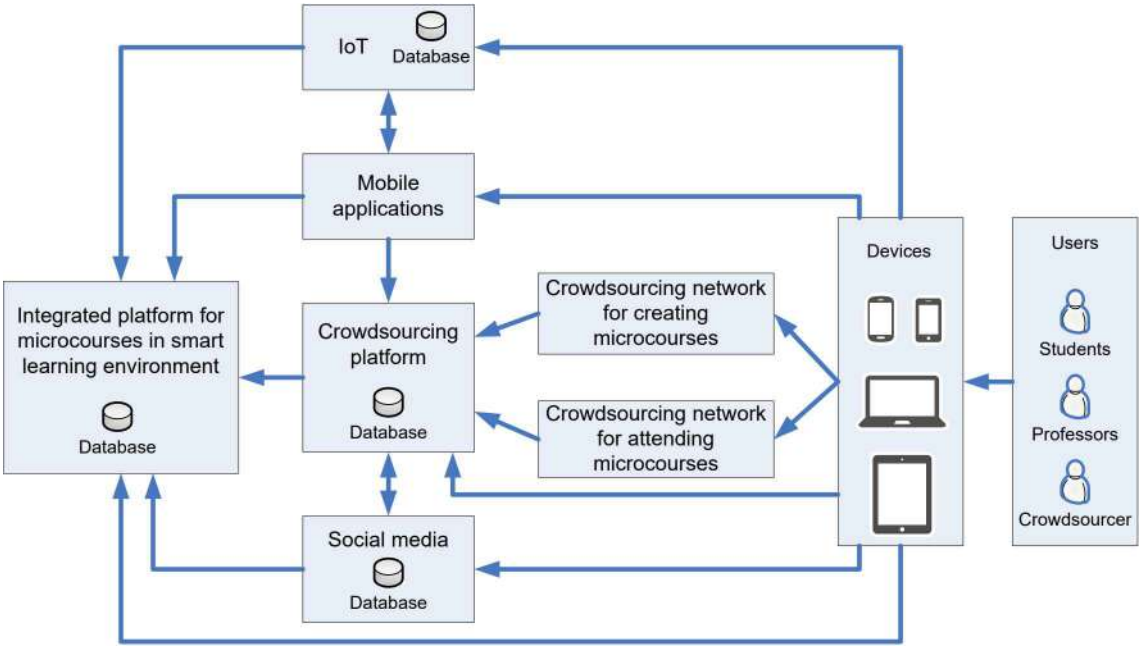


Figure 1: Model of crowdsourcing microlearning in smart learning environments

Crowdsourcing platform, which represents a part of integrated platform, gives an opportunity to the users to become a part of crowdsourcing network for attending or creating microcourses, and to participate in other crowdsourcing activities. The role of social media within the model refers to the possibility to engage networked group of people or to share final results of crowdsourcing activities (e.g. microcourse). Integrated crowdsourcing platform should have an option for personalized tracking of students' activities in real time of the crowdsourcing process. IoT platform can enrich integrated platform with different sensor data in reference to educational environment, localization of students' activities, etc.

3. MATERIALS AND METHODS

The project of crowdsourcing microlearning and evaluation of crowdsourcing mechanisms for e-learning through microcourses has been conducted as part of the study course E-business at Faculty of organizational sciences, University of Belgrade, year 2015/16. Crowdsourcing task referred to creation and attendance of microcourses. The procedure of crowdsourcing microlearning implementation is represented at Figure 2.

The project has been planned, implemented and evaluated under supervision of E-business department professors. The professors had formed a team of five members to represent crowdsourcer. The crowdsourcer had the tasks to: identify and publish potential topics, organize students' applications, form groups together with students, help students, examine the final microcourses, choose a platform for microcourses and to publish good quality microcourses. The project team chose the open platform for microcourses – Coursmos. This platform offers possibility to create free and paid microcourses, and it also provides online certificates for students, testing of students, etc. (Coursmos, n.d.).

The students were invited to participate voluntarily in creating and/or attending microcourses. Both activities were rewarded with bonus points for the final exam.

The task was to create a video microcourse lasting 5 to 7 minutes. The microcourses were created by using software for screen recoding. The period for creating microcourses was two weeks. Totally 123 students participated and 46 microcourses have been created among which 44 had been published on Coursmos platform. The professors evaluated published microcourses according to two criteria: educational and technical quality.

Totally 127 students attended microcourses. Their task was to attend minimum two microcourses, to comment and evaluate microcourses.

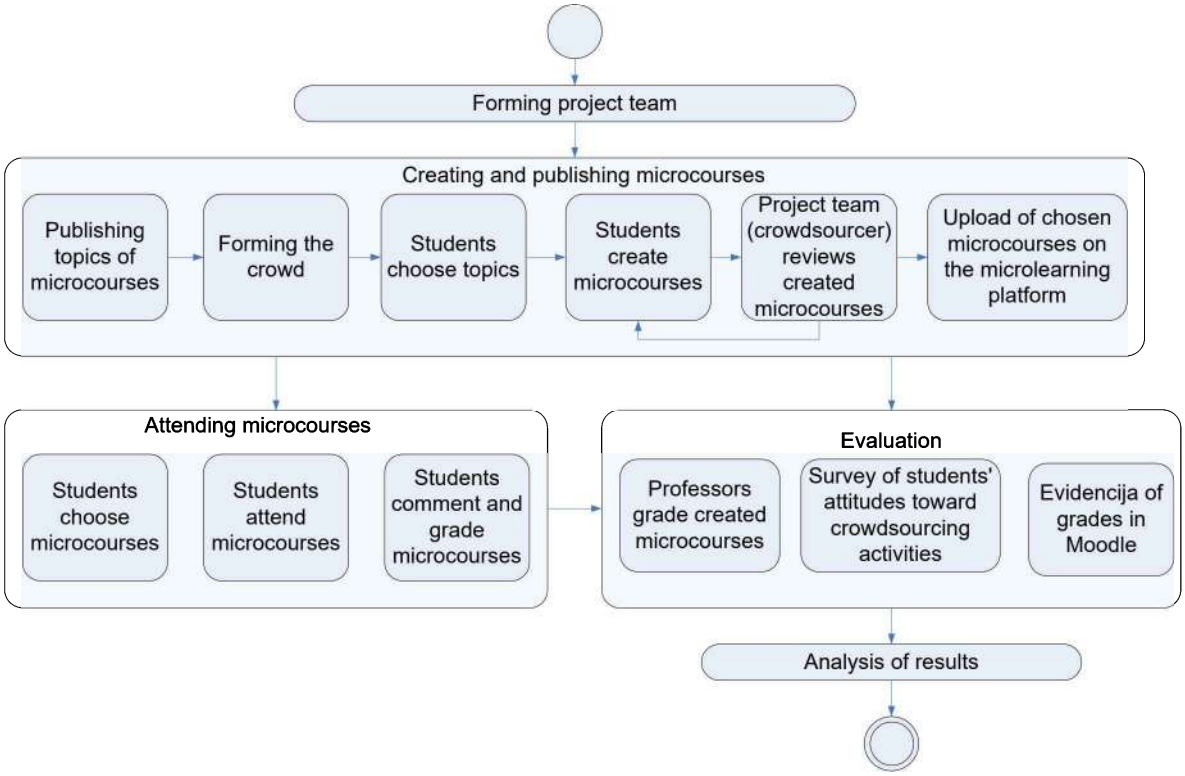


Figure 2: Procedure for implementation of crowdsourcing microlearning

Experiment was conducted as a part of broader experiment in which all students had been included in real conditions. Data were collected through the survey which was given to students at the final exam. The students who attended microcourses were identified through data collected from Coursmos platform. Moodle provided data concerning marks and structure of points at the subject.

The survey was filled out by 271 students, among which 71 created microcourses (sample "created"), and 74 attended microcourses (sample "attended"). Since 39 students created and attended microcourses (stratum "created and attended"), two more strata have been identified: "only created" and "only attended".

The sample "created" included 57.7% of population, and the sample "attended" included 58.3% of population. Characteristics of the samples and strata are given in Table 1. There are missing data on the average grade of students.

Table 1: Characteristics of the sample

		Sample			**Stratum**		
		Whole sample	**„Created"**	**„Attended"**	**„Only created"**	**„Only attended"**	**„Created and attended"**
Number		271	71	74	32	35	39
Gender	**M**	95 (35.1%)	28 (39.4%)	24 (32.4%)	14 (43.8%)	10 (28.6%)	14 (35.9%)
	F	176 (64.9%)	43 (60.6%)	50 (67.6%)	18 (56.3%)	25 (71.4%)	25 (64.1%)
Study programme	**ISIT**	173 (63.8%)	65 (91.5%)	56 (75.7%)	28 (87.5%)	19 (54.3%)	37 (94.9%)
	ME	98 (36.2%)	6 (8.5%)	18 (24.3%)	4 (12.5%)	16 (45.7%)	2 (5.1%)
Average grade	**6-6.99**	4 (1.5%)	0	0	0	0	0
	7-7.99	96 (35.8%)	19 (27.9%)	23 (31.5%)	5 (16.7%)	9 (25.7%)	14 (36.8%)
	8-8.99	126 (47%)	28 (41.2%)	34 (46.6%)	13 (43.3%)	19 (54.3%)	15 (39.5%)
	9-10	42 (15.7%)	21 (30.9%)	16 (21.9%)	12 (40%)	7 (20%)	9 (23.7%)

The survey had 3 parts. The first part was filled out by all students, the second part was for students who created microcourses and the third part was for the students who attended microcourses. The central part of all 3 parts of the survey included measuring students' attitudes on a five-point Likert scale.

The first part of the survey measured the students' attitudes (initial perception) about the relation of collaborative learning and dimensions of e-education, such as: the influence of collaborative projects on e-learning, results of individual/collaborative learning, acquisition of skills and usefulness of accepted technology. Each dimension contained multiple items. This part of the survey also included questions like gender, study programme (ISIT – Information systems and technologies and ME – Management), learning orientation, usage of social media and ranking of motivation factors in collaborative work.

The second part of the survey measured attitudes of students who created microcourses about the influence of collaborative creation of microcourses on the following dimensions of e-learning: satisfaction, learning, skills and incentives. It also measured the characteristics of crowdsourcing activities of individuals and groups.

The final part of the survey involved the group of students who attended microcourses and it consisted of three sets of items. The first set of items measured the influence of attending microcourses on the following e-learning dimensions: satisfaction, learning and usefulness of accepted technology. The second set of items contained students' evaluation of attended microcourses, while the third set of items was used to measure the platform functionalities. Moreover, the following data were also collected: number of attended microcourses, the average time needed to complete microcourse, characteristics of microcourses and activities on the platform.

Cronbach's Alpha was used to investigate internal consistency of the survey for measuring attitudes of students who created and attended microcourses. Cronbach's Alpha values for samples „created" and „attended", as well as for all strata are in interval from 0.832 to 0.922. Furthermore, each question in Cronbach's Alpha if Item Deleted is in the range 0.799 to 0.926. All these coefficients indicate an acceptable level of internal consistency of the used measuring instruments (higher than 0.7).

4. ANALYSIS OF RESULTS

4.1. Analysis of influence of creating microcourses on e-learning

Descriptive statistics was used to analyze the influence of creating microcourses on different attributes and dimensions of e-learning for the whole sample (C), strata "created and attended" (CA) and "only created" (OC) (Table 2). The identified attributes are divided into four dimensions: satisfaction, learning, skills and incentives.

Mean values of eleven attributes are higher for stratum "created and attended" when compared to stratum "only created" and the whole sample. Only the mean value of attribute "bonus points" is higher for stratum "only created". It is obvious that students who participated in the entire project have greater intensity of attitudes regarding influence of creating microcourses on different dimensions of e-learning: satisfaction, learning and skills, as well as on the attribute "recognition of colleagues".

Of all the attributes, "satisfaction related to participation" has the highest mean value for the sample as a whole, as well as for strata "created and attended" and "only created" and it represents the most important attribute. On the other hand, attributes from „incentives dimension" have the lowest mean values for the whole sample and the both strata. Reward in the form of bonus points has the lowest mean value for the whole sample and stratum „created and attended". Attribute „recognition of colleagues" is the least important attribute of creating microcourses for stratum „only created".

„Administrative support of crowdsourcer" is second rated attribute for the whole sample and stratum „only created", and it is the third rated attribute for stratum "created and attended". High average grades of this attribute show high level of understandability of the project for both strata.

Regarding the influence of creating microcourses on "learning dimension", the most important attribute for both strata is "stimulation of creativity". The biggest difference between the strata in this dimension refers to the attribute "stimulation for making an effort for the subject".

There are relatively big differences in mean values for attributes in "skills dimension" between two strata. For stratum "created and attended" the most important attribute is "preferring collaborative skills", while for the whole sample and stratum "only created" it is "advancing teamwork skills". The least important attribute in this dimension for both strata is "advancing scientific-research skills".

Table 2: Influence of participation in microcourses creation on different dimensions of e-learning

Attribute	Mean		
	C	CA	OC
Satisfaction dimension			
Satisfaction related to participation	4.31	4.38	4.22
Administrative support of crowdsourcer	4.06	4.15	3.94
Learning dimension			
Adjustment to learning orientation	3.92	4.03	3.78
Stimulation of creativity	4.00	4.08	3.91
Stimulation for making an effort for the subject	3.73	3.97	3.44
Skills dimension			
Advancing social and communication skills	3.82	4.03	3.56
Preferring collaborative skills	3.97	4.23	3.66
Advancing analytical skills	3.76	4.05	3.41
Advancing teamwork skills	4.03	4.15	3.88
Advancing scientific-research skills	3.54	3.82	3.19
Incentives dimension			
Bonus points	3.17	3.15	3.19
Recognition of colleagues	3.30	3.54	3.00

T-Test was used to determine whether there are significant differences between the two strata regarding influence of creating microcourses on various attributes of e-learning. It was found there are significant differences between these strata ($p < 0.05$) in terms of:

- stimulation for making an effort for the subject($p=0.02$, eta=0.07, effect size=medium to large);
- advancing analytical skills($p=0.02$, eta=0.07, effect size=medium to large);
- advancing scientific-research skills ($p=0.03$, eta=0.07, effect size=medium to large).

4.2. Analysis of influence of attending microcourses on e-learning

Descriptive statistics of influence of attending microcourses on e-learning was used for the whole sample (A), strata “created and attended” (CA) and “only attended” (OA). The three dimensions of influence of microcourses on e-learning were identified: satisfaction, learning and usefulness of accepted technology. The mean values of these dimensions are given in Table 3.

Mean values of all attributes regarding influence of attending microcourses on e-learning for stratum „created and attended“ are higher compared to stratum „only attended“ and sample as a whole. „Acquiring new knowledge“ is the most important attribute for both strata and for the whole sample. The least important attribute for the sample as a whole and the two strata is "adjustment to learning styles“.

Table 3: Mean values of attributes of attending microcourses

Attribute	Mean		
	A	CA	OA
Satisfaction dimension			
Satisfaction related to participation	4.19	4.26	4.11
Learning dimension			
Acquiring new knowledge	4.46	4.51	4.40
Adjustment to learning orientation	3.95	3.97	3.91
Adjustment to learning styles	3.91	3.92	3.89
Stimulation for making an effort for the subject	4.09	4.15	4.03
Usefulness of accepted technology			
Improvement of educational environment	4.28	4.31	4.26
Sharing on social media	4.11	4.28	3.91
Using mobile applications	4.12	4.28	3.94

Regarding attributes in the „learning dimension“ there are no important differences between mean values for the two strata, as well as for the whole sample.

The most important attribute in dimension “usefulness of accepted technology” for the whole sample and the two strata is “improvement of educational environment”. The stratum “created and attended” has the same average grade for attributes “sharing on social media” and “using mobile applications”. Sample as a whole and stratum “only attended” consider “using mobile applications” on platform is somewhat more important when compared to “sharing on social media”.

T-Test results showed that examined population of students who attended microcourses is homogenous in terms of all attributes, so there are no significant differences in attitudes between stratum “created and attended” and “only attended”.

4.3. Comparative analysis of the influence of creating and attending microcourses on e-learning

There are three common attributes identified for samples “created” and “attended”: satisfaction related to participation, learning orientation and stimulation for making an effort for the subject (Tables 1 and 2). By comparing mean values of students’ answers it is found that creating microcourses has higher level of satisfaction and a greater perception of compliance with orientation towards learning than attending microcourses. However, attending microcourses encourages students more to make an effort for the subject than creating microcourses.

Correlation analysis using Pearson coefficient demonstrated the following:

- between all considered attributes for creating and attending microcourses there is statistically significant positive correlation for samples „created“ and „attended“, and for stratum „created and attended“;
- for sample “created” there is moderate to high positive correlation (0.5-0.75) between all included attributes;
- for sample “attended” there is a strong positive correlation (r>0.75) between attributes „adjustment to learning orientation“ and „stimulation for making an effort for the subject“, and moderate to high correlation between attributes „satisfaction related to participation“ on one hand and attributes „adjustment to learning orientation“ and „stimulation for making an effort for the subject” on the other hand;
- for stratum “created and attended”:
    - low to moderate correlation (0.25-0.5) between attributes „satisfaction related to participation“ and „stimulation for making an effort for the subject”, and moderate to high correlation between attributes „adjustment to learning orientation“ on one hand and „satisfaction related to participation“ and „stimulation for making an effort for the subject“ on the other hand;
    - satisfaction in creating microcourses is not associated with satisfaction in attending microcourses;
    - correlation between attributes „adjustment to learning orientation“ in creating and attending microcourses is moderate to high;
    - correlation between attributes „stimulation for making an effort for the subject“ in creating and attending microcourses is low to moderate.

5. DISCUSSION

Implementation of the microlearning project in academic environment confirms that student collaborative projects and crowdsourcing represent important fields of e-education which are oriented towards development of students' participative mechanisms and improvement of educational processes. The identified crowdsourcing mechanisms of microlearning represent adequate framework for using students’ collective intelligence in creating and broadening of knowledge. Students showed readiness and interest for participation in collaborative and crowdsourcing projects (Kapp, 2009).

During the experiment, the group of students who participated in both crowdsourcing projects (creating and attending microcourses) clearly stood out. It was found that students with higher tendency to participate in crowdsourcing by participating in more crowdsourcing projects have increased intensity of satisfaction and intrinsic motivation. It also influences their perception of the usefulness of crowdsourcing on the dimensions of learning and acquiring skills. On the other hand, the higher tendency for participation in crowdsourcing projects reduces the intensity of perception of reward as extrinsic motivator (Hosseini et al., 2014). These findings confirm the mean values of all attributes in identified dimensions of e-learning in both projects.

A particularly important attribute in creating and attending microcourses for all students is "Satisfaction related to participation". This confirms that students accept this way of learning and participating. On the

other hand, the motivation mechanisms through bonus points and recognition by other students proved to be the lowest graded attributes of microlearning.

Acquiring new knowledge is one of the most important functions of microlearning. Students' orientation towards learning is in compliance with activities of creating and attending microcourses. However, creating microcourses encourages students to a lesser extend to make an effort for the subject compared to attending microcourses.

In terms of students' attitudes toward acquiring skills in project of creating and attending microcourses, it is confirmed that the mean values of all attributes of the group that created and attended microcourses are higher than in the group that only created microcourses.

There is a significant difference between strata "created and attended" and "only created" regarding attitudes toward influence of creating microcourses on the following e-learning attributes: stimulation for making an effort for the subject, advancing analytical and scientific-research skills.

Limitations of the research include identification and selection of dimensions and attributes of crowdsourcing creating and attending microcourses, which are mostly based on our own observations of students' behavior and our own model, and to a lesser extent on results of other researches. Indicators of influence of crowdsourcing microlearning on e-learning attributes are based on survey of students' attitudes which limits the interpretation of results. The other limitation of the research results arises from the fact that the experimental population consisted of students who volunteered to participate in this project. While the survey included most of the students who created and/or attended microcourses, we used a convenience sampling, which is a limitation of the research results. Also, implementation of the crowdsourcing project and research was conducted in one higher education institution, so the conclusions can't be fully accepted as generalized, but rather as indicative.

6. CONCLUSION

Integration of collaborative learning and students' collective intelligence through implementation of microlearning project and evaluation of crowdsourcing mechanisms in creating and attending microcourses represents a new approach to e-learning in higher education. An integral model of crowdsourcing microlearning in smart learning environment is developed. Implemented student-centered crowdsourcing model provides an opportunity for students to be both creators and users of knowledge. Crowdsourcing approach to microlearning confirmed interest and willingness of students to collaborate and produce good quality content. It also confirmed high level of self-organization among students. Students who tend to participate in more crowdsourcing projects gave higher grades to influence of microcourses on different attributes and dimensions of e-learning. Identification of students based on these attributes could be predictor variables for their involvement in other crowdsourcing projects.

REFERENCES

Anderson, M. (2011). Crowdsourcing Higher Education: A Design Proposal for Distibuted Learning. *MERLOT Journal of Online Learning and Teaching*, 7, 4, 576-590.

Bogdanović, Z., Labus, A., Simić, K., Ratković-Živanović, V. & Milinović, S. (2015). Harnessing crowdvoting to support students' creativity. In Proceedings of the *7th International Conference on Education and New Learning Technologies*, 4318-4326. Barcelona, Spain.

Cobb, J. & Steele, C. (2014). *Association Learning + Technology*. Retrieved from website: http://www.peachnewmedia.com/wp-content/uploads/2013/12/Tagoras-Association-Learning+Technology-2014.pdf

Coccoli, M., Guercio, A., Maresca, P. & Stanganelli, L. (2014). Smarter universities: A vision for the fast changing digital era. *Journal of Visual Languages and Computing*, 25, 6, 1003-1011.

Coursmos (n.d.). *Why Coursmos?* Retrieved from website: https://coursmos.com/

Cupido, K. & Ophoff, J. (2014). Model of Fundamental Components for an e-Government Crowdsourcing Platform. *Electronic Journal of e-Government*, 12, 2, 142-157.

Dontcheva, M., Morris, R., Brandt, J. & Gerber, E. M. (2014). Combining Crowdsourcing and Learning to Improve Engagement and Performance. In Proceedings of the *SIGCHI Conference on Human Factors in Computing Systems*, 3379–3388. Toronto, Canada.

Fu, F. L., Wu, Y. L. & Ho, H. C. (2009). An investigation of coopetitive pedagogic design for knowledge creation in Web-based learning. *Computers & Education*, 53, 3, 550-562.

Geiger, D., Seedorf, S., Schulze, T., Nickerson, R. C. & Schader, M. (2011). Managing the Crowd: Towards a Taxonomy of Crowdsourcing Processes. In Proceedings of the *Seventeenth Americas Conference on Information Systems*, Paper 430. Detroit, Michigan.

Heigl, F. & Zaller, J. G. (2014). Using a Citizen Science Approach in Higher Education: A Case Study Reporting Roadkills in Austria. *Human Computation*, 1, 2, 165-175.
Heusler A. & Spann M. (2014). Knowledge Stock Exchanges: A Co-opetitive Crowdsourcing Mechanism for E-Learning. In Proceedings of the *22nd European Conference on Information Systems (ECIS)*, 1-14. Tel Aviv, Israel.
Hosseini, M. (2012). Crowdsourcing: Activities, Incentives and Users' Motivations to Participate. *International Conference on Innovation, Management and Technology Research (ICIMTR2012)*, 501-506. Malacca, Malaysia.
Hosseini, M., Phalp, K., Taylor, J. & Ali, R. (2014). The four pillars of crowdsourcing: A reference model.*The IEEE Eight International Conference on Research Challenges in Information Sciences,* 1-12. Marrakesh, Marocco.
Hou, T., Gou, X. & Gao, Y. (2016). Preliminary Application of Micro-Course in Distance Education. *International Journal of Information and Education Technology*, 6, 2, 132-136.
Howe, J. (2008). *CROWDSOURCING - Why the Power of the Crowd is Driving the Future of Business.* Retrieved from website: http://www.bizbriefings.com/Samples/IntInst%20---%20Crowdsourcing.PDF
Kapp, E. (2009). Improving Student Teamwork in a Collaborative Project-Based Course. *College Teaching*, 57(3), 139-143.
Llorente, R. & Morant, M. (2015). Crowdsourcing in Higher Education. In Garrigos-Simon, F. J. et al., *Advances in Crowdsourcing,* 87-95. Switzerland: Springer International Publishing.
Ochoa, X. & Sprock, S. A. (2011). Collaborative Open Textbooks for Latin America the LATIn Project. *2011 International Conference on Information Society (i-Society)*, 398-403. London, England.
Pardoe, D. (2009). *Towards successful learning*. London: Continuum International Publishing Group.
Pedersen, J., Kocsis, D., Tripathi, A., Tarrell, A., Weerakoon, A., Tahmasbi, N., Xiong, J., Deng, W., Oh, O. & deVreede, G. J. (2013). Conceptual Foundations of Crowdsourcing: A Review of IS Research..*46th Hawaii International Conference on System Sciences*, 579-588. Wailea, Maui, HI.
Saxton, G. D., Oh, O. & Kishore, R. (2013). Rules of Crowdsourcing: Models, Issues, and Systems of Control. *Information Systems Management*, 30, 1, 2-20.
Shen, G. & Shen, S. (2015). Study of Construction of Micro-Course in the Major of Social Work. *Higher Education of Social Science*, 9, 4, 9-12.
Simoes, J., Redondo, D. R. & Vilas, R. (2013). A social gamification framework for a K-6 learning platform. *Computers in Human Behavior*, 29, 2, 345–353.
Skaržauskaitė, M. (2012). The application of crowd sourcing in educational activities. *Socialinės technologijos - Social technologies*, 2, 1, 67-76.
Smith, B. L. & MacGregor, J. (1992). What is collaborative learning. In A. S. Goodsell, M. R. Maher & V. Tinto (Eds.), *Collaborative Learning: A Sourcebook for Higher Education* (10-29). University Park, PA: National Center on Postsecondary Teaching.
Spector, J. M. (2014). Conceptualizing the emerging field of smart learning environments. *Smart Learning Environments*, 1(1), 1–10.
Sun, G., Cui, T., Yong, J., Shen, J. & Chen, S. (2015). Drawing micro learning into MOOC: using fragmented pieces of time to enable effective entire course learning experiences. *IEEE 19th InternationalConference on Computer Supported Cooperative Work in Design*, 308-313. Calabria, Italy.
Tarasowa, D., Khalili, A., Auer, S. & Unbehauen, J. (2013). CrowdLearn: Crowd-sourcing the Creation of Highly-structured E-Learning Content. In Proceedings of the *5th International Conference on Computer Supported Education,* 33-42. Aachen, Germany.
Vassileva, J. (2008). Towards Social Learning Environments. *IEEE Transactions on Learning Technologies*, 1, 4, 199-214.
Wei, Y., Yang, Y., Zeng, X. & Yu, L. (2015). The Design and Application of Primary and Secondary Teacher Training Oriented Micro-Course. *Creative Education*, 6, 718-725.
Zhu, C. (2012). Student Satisfaction, Performance, and Knowledge Construction in Online Collaborative Learning. *Educational Technology & Society*, 15, 1, 127–136.

AUGMENTED REALITY AND MOBILE LEARNING

Slavica Štrbac*, Biljana Grgurović, Vitomir Radosavljević
ICT College of Vocational Studies, Belgrade, Serbia
*Corresponding author, e-mail: slavica.strbac@ict.edu.rs

Abstract: The concept of mobile learning has been gaining popularity in new lecture planning methods owing to the advancement and the increased use of new devices and technologies, such as smart and tablet devices. Augmented reality (AR) nowadays represents one of the possible applications of smart mobile devices. New technologies should not serve only as a tool for learning, but as a means to provide students with easier access to information, to increase the level of active learning, to improve cooperation, enable interaction and increase motivation in students. The AR technology offers a new experience when accessing the exiting data which, in itself, represents an additional motivational factor. This paper consists of potential uses for AR technology integrated into smart mobile devices, for the purposes of education, with emphasis on mobile learning.

Keywords*: augmented reality, mobile learning, smart devices*

1. INTRODUCTION

Increasing usage of mobile devices can be promptly directed to an entirely new direction, the direction of education, consequently, implementing education into a new way of life and consciousness of young generations. On the other hand, the users of wireless mobile devices, in accordance with their growing requests regarding everyday choice of services, will inevitably insist on the possibility of education in this way. Current development of technology is on the level which can respond to such requests (Štrbac, Grgurović, Jelić, 2010).

The increase in numbers of smart mobile devices, as well as applications for these devices, open a new dimension of everyday use, from reading different materials, to observing, to taking in some of the materials. Most educational applications are developed so that they respond to the interests of school children, but students should not be left out either, as well as adults, in the program of lifelong learning.

M-learning is a contemporary form of education and training using mobile devices. The concept of m-learning has become popular in lecture planning because of the advancement and increased use of new devices as technologies such as tablet and smart devices (Alioon, Delialioglu, 2015). With the development of smart devices, the number of educational mobile applications has increased as well. Generations of school children are growing up with mobile devices, using them for communicating, connecting, sharing data, gathering information, education.

Augmented reality, on the other hand, enables the superposition of objects in real time, which makes it possible to add digital information to physical objects. Contemporary smart devices, owing to their performance specifications, enable AR displaying, which opens the possibilities of using AR for educational purposes, via numerous real-time actions, such as:

- Displaying materials in real time,
- Geo-locating users,
- Using stored data in a device,
- Recording real objects,
- Combining the aforementioned actions.

It should also be emphasized that AR technology-supported mobile devices enable using only one (mobile) device, instead of using numerous peripheral devices designed for AR. Mobile devices also represent an ergonomic improvement in mobile device applications for learning, as they include sensors for displaying AR (GPS, inertia sensors, accelerometers, compass, Wi-Fi).

Designing and implementing new approaches to learning require careful surveillance from both perspectives, technical and pedagogical. The pedagogical aspect can be assessed through the following six elements: integration of ubiquitous technology into the system, theoretical basis, research on programming and

coordination, teacher accessibility, adjustment of activities to the configuration and characteristics of a device, and evaluation (Jairak, Praneetpolgrang, Mekhabunchakij, 2009).

The technical aspect includes mobility, immediacy, individuality, connection,and accessibility as main characteristics of mobile devices around which mobile learning revolves (Korucu, Alkan, 2011).

Many authors have researched different aspects of mobile devices. This includes, above all, their role and use, as well as their efficiency in educational domains. Aside from these roles, the readiness of students to accept the device use also stands out (Ally, 2009), (Kennedy, Judd, Churchward, Gray, Lee- Krause, 2008), (Abas, Peng, Mansor, 2009).

The idea behind m-learning as a way of improving the traditional way of learning by use of AR technology has been gaining more significance, most of all because of the fact that it offers a unique visual and interactive experience.

2. M-LEARNING – THE BASIS FOR AUGMENTED REALITY

The main advantage of m-learning is the possibility of continual access to educational materials through a mobile device at any given time from any location. For the last few years, mobile applications have been improving by means of integrating new possibilities, service operators have been competing in application offers, all with the goal to create a new experience for users. Higher education has been keeping up with the trend of increase use of mobile devices through situational learning.

The current concept of higher education has the potential to utilize the space out of the classroom by improving e-learning and m-learning. M-learning has a potential advantage over e-learning (figure 1) (Pachler, Bachmair, Cook, 2009) keeping in mind that, aside from the main advantage of mobility, the following three m-learning characteristics also exist:

- The use of mobile devices by students who are applying and using specific tools adjusted to mobile technologies;
- Out-of-classroom learning, while providing the students with the support in different learning situations;
- The students' need for mobility, which provides the students with the ability to learn any time (Zapata-Ros, 2012).

With the increasing use of smart devices, the demand for AR applications has also been on the rise. Contemporary smart devices combine fast processors with graphics hardware, gradually larger touch-sensitive screens, sensors (camera, GPS, compass, accelerator), which makes them ideal for AR experience in and outside of the classroom. Researchers and commercial programmers have the opportunity to use these platforms for developing educational programs and enabling new learning experiences.

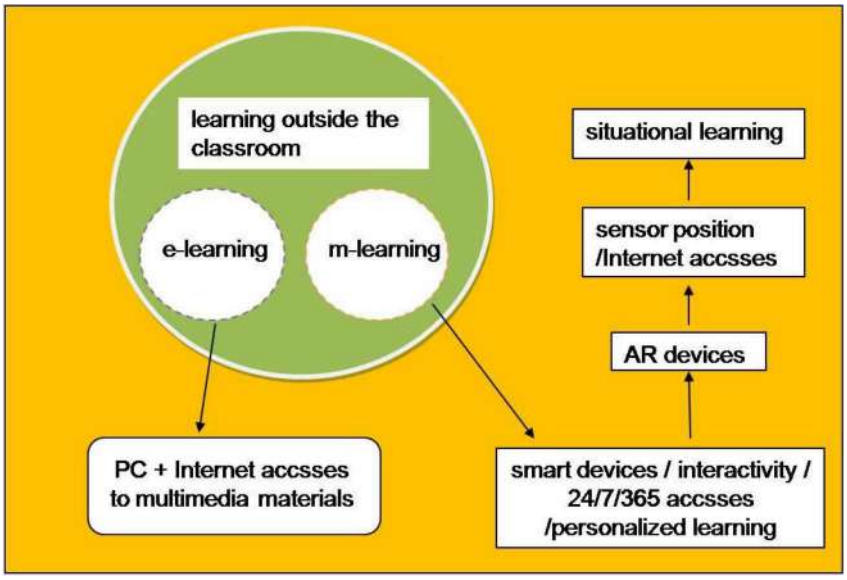


Figure 1: E-learning and m-learning in educational surroundings

The research on this topic has shown that offering AR experiences through mobile devices can have a unique advantage over materials which do not offer this experience.

3. AUGMENTED REALITY AND EDUCATIONAL MATERIALS

Augmented reality can be viewed as an extension of reality. It ensures displaying surroundings-related virtual information, while also enabling the digital information differs depending on the device on which it is viewed. If we view the human body as an interface which experiences its surroundings through visual, auditory, somatosensory, olfactory, and gustatory senses, augmented reality is a form of extension which amplifies the perception of an outer interface.

Using AR technology on mobile devices in adaptive surroundings puts the emphasis on the level of personalization. A student advances independently, by his or her own pace, according to his or her own interests and capacities. The advancement in learning is presented to students through interactivity with their own surroundings, which enables them to move on to new materials and new tasks. Technology provides access to resources which improve learning by means of a more efficient, better reality. The main idea is to use additional educational information to make an impact on the perspective, understanding and meaning of decision-making in reality.

3.1. AR System Functioning

AR system components can be put into three categories: displaying, following, and interacting.

The displaying components enable users to display an optical or video version of materials, depending on whether they are trying to view individual images or video recordings. The device construction plays a crucial role in determining where the display will be placed relative to the user (on their heads, in their hands, or spatial).

The following components serve to integrate virtual information (text, images, 3D) into real surroundings. These components depend on the viewer's position and the device position. The accuracy of orientation does not only depend on the device position, but on the rotation, direction of moving, and slope as well. The following component is defined by six points (coordinates X, Y, and Z, rotation, slope, and yaw). Overall, the following components can be put into three groups: sensory, visual, and hybrid.

Interaction is a category which requires the most attention, since it is necessary to establish a connection between the user and the virtual materials. The basis of interaction are activities such as: managing, copying, commenting, erasing virtual objects and materials, or information. The access interface, during the interaction between the user and the AR materials, depends on the GUI version, and the keyboard, mouse or screen are most commonly touch-sensitive. Interaction styles can be divided into: direct management, menu selection, entry form, programming and natural language (Gesa, 2012). It is also essential to follow the so-called eight golden rules when designing the interface: consistency, including shortcuts for experienced users, feedback option, specially designed problem-solving dialogue, simple handling in case of errors, simple undo option, user support control, and the release of short-term memory.

3.2. Possibilities in AR application in education

Using AR application, the existing educational materials are enriched with virtual materials, which remain invisible to others. In this way, students are offered a new layer of knowledge, new level of information, or a visual guide through the materials and tasks.

When it comes to the materials which can be offered through AR technology in educational purposes, the methodology of clearly forming such materials does not yet exist (Mesarošova, Ferrer Hernandez, Mesaroš, 2014).

Expanding educational space to mobile devices can increase students' attention. In order to make students feel a part of the technological space and participate in activities, it is necessary to design the surroundings. The surroundings created with mobile devices increases the communication span in everyday life, and could thus be used to increase students' attention in classroom and when learning (Pachler, Bachmair, Cook, 2009).

Some studies have researched the implementation of AR technology into education. One of these studies, a study from the University of Nottingham, which researched the expansion of viewers experience in Lake District, where geography students can access additional information about their surroundings through a helmet-like display (Shneiderman, 1997). Another study from the same university was done with history students, who gained access to additional information on places of historical events through smart phones,

based on their GPS positions (Priestnall, Brown, Sharples, Polmear, 2010). AR can also be used as a supplement to traditionally written books, as a way of teaching storytelling skills, or to satisfy the desire to read the (non-)obligatory bibliography (FitzGerald, 2012).

3.3. Challenges in AR application in education

As any new technology which is widely applied, AR technology faces challenges in its implementation into education. Some of those challenges are:

- Overcoming innovation factors, since every innovation must show improvement compared to the existing sustainable teaching methods;
- Problems with the use of equipment in real-life situations, such as display size, device behavior in outdoor conditions (display reflection, etc.);
- Stepping out of informal into the formal education by introducing innovations into official lecture plans, which requires accreditation;
- Changing the existing practices;
- The question of appropriateness of the media to reality (the notion of misappropriation).

In order to overcome some of the aforementioned challenges, a short study was conducted at the ICT College of Vocational Studies involving first-year students, researching their will and opportunity to use smart mobile devices for learning.

Out of 53 respondents, 96 per cent of them already own a smart mobile device (image 2), but only 58 per cent use it for purposes of learning (figure 2). It is obvious that there is a potential for the use of smart mobile devices for purposes of m-learning.

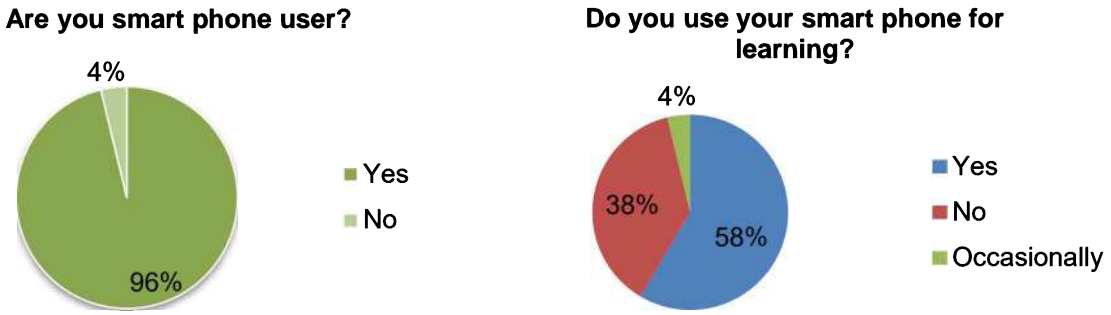


Figure 2: The number of smart phone users and the number of those who use smart phones for learning

This is also supported by the fact that a large number of participants (79 per cent) would install additional m-learning applications (figure 3), as well as the fact that 69 per cent of the students prefer lectures which involve combined multimedia (text, pictures, video material) (figure 4).

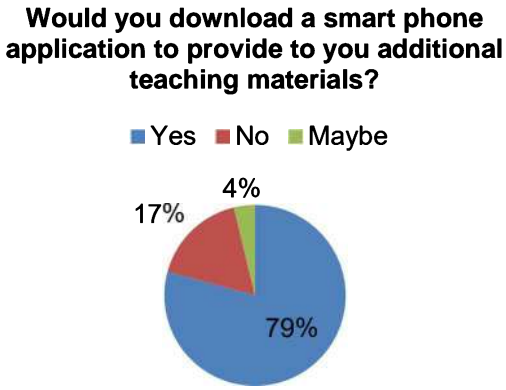


Figure 3: Number of students who would download an additional application for m-learning

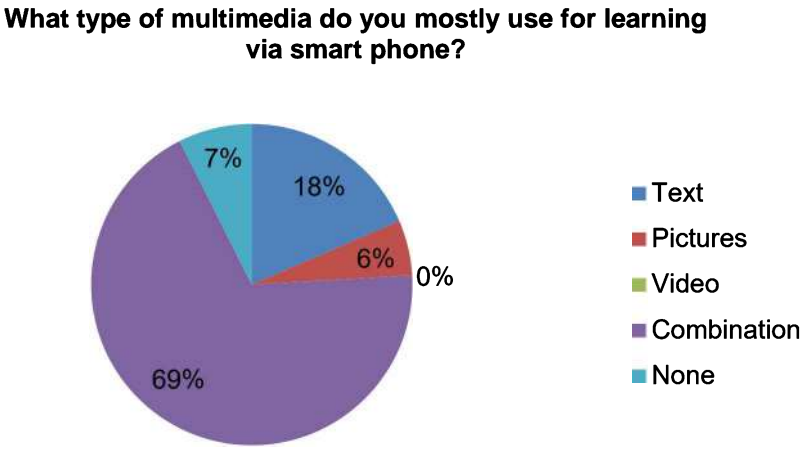


Figure 4: Multimedia materials used on smart mobile devices

Since this group of students largely prefers the Android platform – about 90 per cent of them (image 5), the potential m-learning application should be made for this platform.

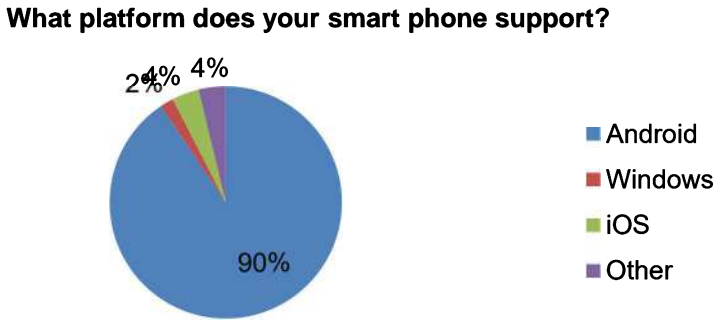


Figure 5: Frequency of mobile OS

4. CREATING AUGMENTED REALITY FOR EDUCATIONAL PURPOSES

Over previous years, m-learning has mostly been analyzed in elementary and high-school contexts, and thus the future of m-learning lies in higher education and education of adults (Alioon, Delialioglu, 2015).

Providing AR experience does not necessarily result in more effective learning. As with any technology, the most important lessons to be learned are those concerning the optimal use of AR in educational contexts. Whether or not the effectiveness will be greater if the traditional teaching materials are only enhanced with AR experiences, or with completely new materials with integrated AR elements, remains to be seen.

Creating teaching materials enriched with AR elements is becoming increasingly simpler. Namely, there is a large number of tools which do not require programming knowledge for creating such materials (buildar, artofillusion, wikitude, yalp, etc.). This offers students not only the possibility to observe the prepared materials, but to actively take part in creating them. The process of creating AR scenes carries in itself certain educational value, since students have to think of ways to use technology in order to introduce complex concepts. In addition to this, working on producing and using materials includes processing and solving problems using team work. This combination could affect motivation, involvement and commitment of students. When they create materials using AR creating tools, students create their own AR experiences and ensure further learning.

Support with displaying educational materials through multimedia, digital materials, such as 2D and 3D images, sounds, and video materials, enables students to notice, memorize, and understand information better. This implies especially to students who have difficulties understanding the traditionally written materials (McKenzie, Darnell, 2004). According to a study where participants read books with and without AR elements, the group which used AR elements noticed things better and reproduced information more

effectively later (Billinghurst, Duenser, 2012). It is interesting that application of AR in education gives the best results in high-school education (Moreno, Mayer, 2005).

The interactive element which AR brings is the key element to success. Namely, when using interactive materials, students see learning as a game, which can prove to be very important when creating materials and overcoming the usual learning limitations.

4.1. The potential benefits of the application of AR in education

Most AR systems are created as a prototype for a certain project or purpose, and it is difficult to compare any results gained that way.

In general, books with AR elements have the potential for high-quality and very employable educational material, in laboratory conditions, as well as in traditional classrooms. In addition to this, intuitive interactions and spatial 3D material visualizations can increase the value of educational materials. Another important value of AR is the possibility to gain skills and experiences which students should overcome with real jobs, which they will get after graduation, as their goals.

A special value of AR is related to the aforementioned interactivity dimension. Some researches claim that interactivity can result in learning and activating certain cognitive processes (Dünser, 2008). A high level of interactivity enables better learning, especially in students who learn through kinetic, visual, and other methods which are not based on a text. In this way, the learned materials are stored as long-term memory. Students who interact with materials can remember more than students who passively receive data. Aside from that, they are better at applying what they have learned.

5. CONCLUSION

Using AR in classroom is still a relatively new notion, but the impact of new technologies has been on the rise ever since AR system platforms became widely accessible. At the moment, experiences are directed only towards the visual expansion of the real world, but several key ideas have been established when it comes to using AR in class:

- AR technology is strong enough to support experiences, especially in the form of extended books and mobile AR learning applications;
- AR experiences should be used as a complement, and not as a substitution to traditional teaching materials;
- AR offers real benefits when reading, through understanding spatial data, especially for students who have difficulties with understanding traditional learning materials.

As the use of AR technology is expanding, the educational model is most likely to be completely different for students who have mobile devices with AR applications.

Based on the insight into the way and frequency of use of smart mobile devices in college students, it can be concluded that there is a great potential for using mobile devices for m-learning purposes. Future m-learning applications, especially when it comes to AR, should be designed for operating systems most frequently used.

Future educational AR experiences will be offered through video channels supplemented with audio and kinetic channels, with a wide variety of interactions. For example, while walking around and using a mobile AR application, a student should be able to hear audio data related to a certain place, as well as see visual signs. This multimodality can be a part of materials which enrich learning experiences and transfer ideas in different forms. These materials can be delivered to students with different preferences when it comes to learning and different learning styles, through active involvement in new, individual ways of learning.

Introducing hardware devices of new capacities, flexible and collapsible displays, 3D cameras, pico projectors, etc. will bring new ways for displaying and interacting with AR materials.

Future AR technology will enable a wider spectrum of educational experiences. Research in new areas open up possibilities for applying abstract concepts to practical lectures. The technology itself enables creation of materials, so that a way is made for students to create materials themselves, who, in this way, experience real-life situations which they can encounter in real-life surroundings.

REFERENCES

Abas, Z.W., Peng, C.L., & Mansor, N. (2009). A study on learner readiness for mobile learning at Open University Malaysia. *IADIS International Conference Mobile Learning*, Barcelona ,Spain.

Alioon, Y., & Delialioglu, O. (2015), A Frame for the Literature on M-learning, Procedia - *Social and Behavioral Sciences* 182, 127 – 135. doi:10.1016/j.sbspro.2015.04.747

Ally, M. (2009). *Mobile Learning: Transforming the delivery of Education and Training.* Published by AU Press, Athabasca University.

Billinghurst, M., & Duenser, A. (2012). Augmented reality in the classroom. Computer, (7), 56-63. *IEEE Computer Graphics and Applications*.

Dünser, A. (2008). *Supporting low ability readers with interactive augmented reality*. Annual Review of CyberTherapy and Telemedicine, 39.

FitzGerald, E. (2012). Assessing informal learning: a case study using historical audio guides. Proceedings of *CALRG Conference* 2012, 9-10.

Gesa, R. F. (2012). *Combinando la realidad aumentada con las plataformas de e-elearning adaptativas*. Enl@ ce, 9(2).

Jairak, K., Praneetpolgrang, P., &Mekhabunchakij, K. (2009). An acceptance of mobile learning for higher education students in Thailand, The *Sixth International Conference on e-learning for Knowledge-Based Society*. Bangkok, Thailand.

Kennedy,G.E., Judd,T.S., Churchward,A., Gray, k., & Lee- Krause, K. (2008). First year students' experiences with technology: Are they really digital natives? *Australian Journal of Educational Technology*, 24(1), 108-122.

Korucu, T., & Alkan, A. (2011). Differences between m-learning (mobile learning) and e-learning, basic terminology and usage of m-learning in education. *Social and Behavioral Science*, 15, 1925-1930. doi:10.1016/j.sbspro.2011.04.029

McKenzie, J. & Darnell, D., (2004).*The eyeMagic Book. A Report into Augmented Reality Storytelling in the Context of a Children's Workshop*, 2003, New Zealand Centre for Children's Literature and Christchurch College of Education.

Mesarošova, A., Ferrer Hernandez, M., & Mesaroš, P., (2014). Augmented reality as an educational tool of m-learning focused on architecture and urban planning, *ICETA 2014, 12th IEEE International Conference on Emerging eLearning Technologies and Applications*, Slovakia, doi:10.1109/ICETA.2014.7107605

Moreno, R., & Mayer, R. E. (2005). Role of Guidance, Reflection, and Interactivity in an Agent-Based Multimedia Game. *Journal of educational psychology*, 97(1), 117.

Pachler, N., Bachmair, B., & Cook, J., (2009) *Mobile learning: structures, agency, practices*, Springer Science & Business Media.

Priestnall, G., Brown, E., Sharples, M., & Polmear, G. (2010). *Augmenting the field experience: A student-led comparison of techniques and technologies*. In E. Brown (ed.) Education in the wild: contextual and location-based mobile learning in action. Nottingham, UK: University of Nottingham: Learning Sciences Research Institute (LSRI), 43-46.

Shneiderman, B. (1997). *Designing the user interface: strategies for effective human-computer interaction*. 3. ed., Addison-Wesley Longman Publishing Co., Inc. Boston, MA, USA.

Štrbac, S., Grgurović, B., & Jelić, G., (2010, March). The application of mobile technology in higher education, *INFOTEH-JAHORINA* Vol. 9, Ref. E-IV-7, 649-653.

Zapata-Ros, M. (2012). *Calidad y entornos ubicuos de aprendizaje*. RED, Revista de Educación a Distancia, 31.

SEMANTIC MODEL FOR ADAPTIVE E-LEARNING SYSTEMS

Jasmina Perišić*[1], Zorica Bogdanović[2], Igor Đurić[2]
[1]Faculty of real estate management, Union University Nikola Tesla, 62, Cara Dušana str., Belgrade, Serbia
[2]Faculty of Organizational Sciences, University of Belgrade, 154, Jove Ilica str., Belgrade, Serbia
*Corresponding author, e-mail: jasmina.perisic52@gmail.com

Abstract: *This paper describes a model for creating semantic elements* for *the current learning management systems (LMS). Propsed model is based on ontology and semantic web technologies. The goal of this paper is to enable dynamic mechanisms for real time mapping, semantic annotation, learning resources enrichment, student profile creation and personalization according to the adaptation criteria. Selected criteria for adaptative systems is the Felder-Silverman learning style model (FSLSM). Also, this work describes real time monitoring of students activities on Facebook social network and learning resources enrichment from external academic open repositories by tags and criteria of adaptation. Several modules (plug-ins) have been implemented.*

Keywords*: semantic web, ontologies, learning objects, adaptive learning, personalization, learning styles.*

1. INTRODUCTION

The main characteristic of e-learning systems is their ability to recognize students needs, their educational behavior and also, their capabilities. In an educational environment, learners with diverse learning capacities and background information require different learning paths (Brusilovsky, 2012). Each student has his own characteristics (profile, learning style, prior background and learning objectives). These individual attributes are very useful to provide each student the most adequate learning path to accomplish his learning outcomes.

LMSs (Learning Management Systems) are platforms for administrating, documenting and delivering e-learning content. They offer the enrolled students a vast number of courses with highly customizable capabilities. A way to automatically plan student-oriented learning content in Moodle was built in (Caputi & Garrido, 2015). For personalized e-learning, several different strategies and characteristics can be used and considered by teachers and course authors/designers (Dorça, Lima, Fernandes, & Lopes, 2013).

Adaptation is a key element in web based learning systems. Most of the existing learning management systems focus on adaptivity in general, whereas others focus more specifically on adaptivity based on learning style (Popescu, 2009). There are many different learning style models that adaptive e-learning systems are generally based on. An automatic, dynamic and probabilistic approach for modeling students learning styles based on reinforcement learning was presented in (Dorça et al., 2013). Another method based on adaptive content presentation, communication methods, and organization of online activities to students' learning styles and preferences was described in (Despotović-Zrakić, Marković, Bogdanović, Barać, & Krčo, 2012). Trends and approaches within this area are covered in (Somyürek, 2015).

Learning styles can be defined as strategies, or regular learning manners usually applied by an individual, which are built on student's fundamental potentials (Kurilovas, Kubilinskiene, & Dagiene, 2014). Learning styles are one of the criteria that adaptation of online courses can be made. In this paper, Felder-Silverman model (FSLSM) is selected because there are the questionnaire and the comprehensive guide on how to use it provided (Felder & Silverman, 1988). In addition, this model has been turned out to be powerful in numerous adaptive learning systems and it has often been used in technology-enhanced learning in order to deliver personalised content adapted to student's learning styles.

Learning objects (LO) have become a fundamental element to develop educational content for e-learning environments. In the modern educational systems number and complexity of learning objects is large. Therefore, there is a problem in the creation, maintenance and retrieval of semantic academic libraries and repositories. Also, many of them are not open. Thus, there is a limited number of semantic repositories or many of them which in different ways describe the same concept. These problems can be solved by developing a personalized, dynamic, semantically-oriented model for annotation and enrichment of learning object. This mechanism involves mapping procedures, adaptations and visualization of certain educational resources in accordance with the rules defined in ontologies. One possible solution for adaptation is an

approach for recommending personalization strategies based on the learning objects included in the course presented in (Essalmi, Ayed, Jemni, & Graf, 2015). In this work it was also evaluated how well these strategies support particular combinations of learner's characteristics.

Semantic web, ontologies and rule-based reasoning play a major part in the development of knowledge and personalized student's profile (Nafea, Maglaras, Siewe, Smith, & Janicke, 2016). Semantic web technologies can be applyed for e-learning systems (Begam & Ganapathy, 2013; Qwaider, 2012; Sheeba, Begum, & Bernard, 2012) and can be used for intelligent discovery of learning objects (Hsu, 2012). They significantly affects the annotation of learning objects, their transformation and semantic enrichment. The advantage of using an ontology is made possible by overcoming interoperability problems between different e-learning systems, as well as the re-use of knowledge in the field to which it relates. Of particular importance to the subject of this paper is to describe the ontologies and rule-base reasoning field of adaptive and personalized e-learning.

Ontologies are open vocabularies, models that describe the world common types, attributes, and relations. Any form of relationship between two concepts can be expressed using strongly typed relations. A short, concise definition of ontologies states that they are a "formal, explicit specification of a shared conceptualization" (Gruber, 1993). Ontologies are powerful and extendable and can be used to personalized knowledge search and recommendation (Chen, Chu, Chen, & Chao, 2013) and extending moodle functionalities (Rezgui, Mhiri, & Ghédira, 2014; Yunianta, Yusof, Jayadianti, Othman, & Suhaimi, 2014). In our study we used Protégé for ontology development because it is the most popular and widely used ontology and knowledge based editor. Also, it has flexible knowledge model and extensible plug-in architecture (Malviya, Mishra, & Sahu, 2011).

There is an increasing demand for sharing learning resources between existing learning systems to support reusability, exchangeability, and adaptability. One approach reccomends a domain-independent, automatic and unsupervised method to detect relevant features from heterogeneous textual resources, associating them to concepts modelled in a background ontology (Vicient, Sánchez, & Moreno, 2013). Generally, the learning resources need to be annotated with ontologies into learning objects that use different metadata standards. These ontologies have introduced the problems of semantic and structural heterogeneity. There are many ways to overcome these problems and one of them is a semantic ontology mapping for interoperability of learning resource systems presented in (Arch-Int & Arch-Int, 2013).

2. LITERATURE REVIEW

Adaptivity in e-learning can be based on the learning flow, where learning and sequence of activities dynamically adapt to each student, or can be based on content, where educational resources and activities available to students dynamically change. In both cases, it is necessary to introduce educational activities and used them as learning objects. Quality of personalized e-learning systems depends on appropriately selected learning objects, their relationships and criteria of adaptation.

In the case of e-learning, learning materials and sources are primarily digital in nature. This allows them to be easily modified in order to adapt to users' needs and learning context. Student-created and professionally-created learning materials can be found on the internet in various formats. The amount and diversity of available resources are becoming an issue for both the learners and the information systems that facilitate learning. Using a descriptive and a standardized set of attributes (metadata), the aforementioned problems can be solved. IEEE Learning Object Metadata (IEEE Learning Technology Standards Committee, 2002) is a prominent metamodel for description of learning objects. Another popular set of standards, based on the IEEE LOM, is Sharable Content Object Reference Model (SCORM). SCORM learning objects are packed into content packages of specific structure, and are based around the use of web-centric technologies, HTML pages and interactivity with the system. Many resources like research papers, student-created materials, links to web pages, etc. do not naturally fit into this concept. In order to facilitate easier and automated searching and indexing of diverse learning resources, a simplier, implementation-agnostic set of metadata is likely a better match.

The evolution of learning processes is almost always linked to social changes and/or technological changes. One of those processes is e-learning, which is involved in the changes brought by web 2.0 trends. This new tendencies consider the user, socialization and collaboration as the main important elements and this must be considered also in e-Learning contexts. Web Services can be applied to define open learning environments (Conde, García, Casany, & Alier, 2010). Social networks, for example Facebook, can be used as e-learning tool for higher education institutes (Ainin, Naqshbandi, Moghavvemi, & Jaafar, 2015; Manasijević, Živković, Arsić, & Milošević, 2016; Qureshi, Raza, & Whitty, 2014).

The transition from the traditional web to Semantic web (relational databases (RDB) to semantic graphs) requires new structuring of data. In this context, we propose D2RQ server which allows automatic extraction of data from RDB and their restructuring in the form of RDF graphs using the Jena API to make them available for the Semantic Web (Bakkas & Bahaj, 2013; Bäumer, Gim, Jeong, Geierhos, & Jung, 2014). On D2RQ server it is possible to execute SPARQL queries over semantic base and also get a semantic data (Calvanese, Cogrel, Komla-ebri, Kontchakov, & Lanti, 2015). These data are later transformed into the semantic subset - OWL model. The goal of our stady is to create an ontology model, and to enrich it with the components of the RDB schema using different classes provided by the Jena API. Jena Semantic Framework also enables implementation of the semantic web recommendations (Carroll et al., 2004).

Pellet is the first sound and complete OWL-DL reasoner with extensive support for reasoning with individuals, user-defined datatypes, and debugging support for ontologies (Sirin, Parsia, Grau, Kalyanpur, & Katz, 2007). The OWL API (Application Programming Interface) represents Java API for OWL ontologies. The OWL API supports parsing and rendering of the syntaxes defined in the W3C specification, manipulation of ontological structures, and the use of reasoning engines. The reference implementation of the OWL API, written in Java, includes validators for the various OWL 2 profiles. The OWL API has widespread usage in a variety of tools and applications (Horridge & Bechhofer, 2011).

Rule sets in SWRL (Semantic Web Rule Language) have the fundamental role of being the inference engine to create new knowledge inside the Semantic Web. SWRL allows the combination of rules and ontology terms defined using the Web Ontology Language (OWL), increasing the expressiveness of both of them (Hassanpour, O'Connor, & Das, 2010).

3. SEMANTIC MODEL FOR ADAPTIVE E-LEARNING SYSTEMS

Our research differs from previous works in relation to several aspects. We provided personalized student profile based on the learner's behavior pattern using FSLSM model. Educational resources from external academic semantic repositories were enriched using the mechanisms of visualization. Also, adaptive learning was supported using different types of techniques such as ontologies and inference rules. The proposed model is not only intended to ensure the learner's ability to learn, but it is also expected to be useful in providing a learning path and guidance based on individual differences (learning style). Personalized guidance is achieved by collecting a student's initial capability and preferences and by using semantic rules and rule-based reasoning in order to detect learner behavioral changes.

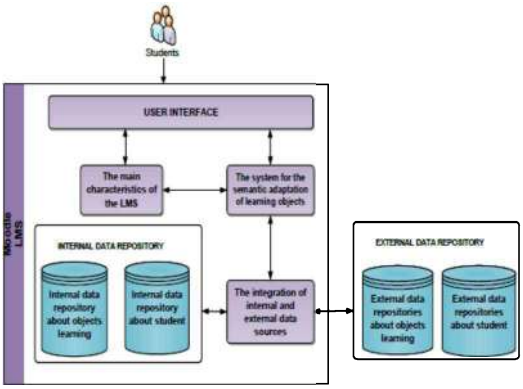


Figure 1: The model architecture

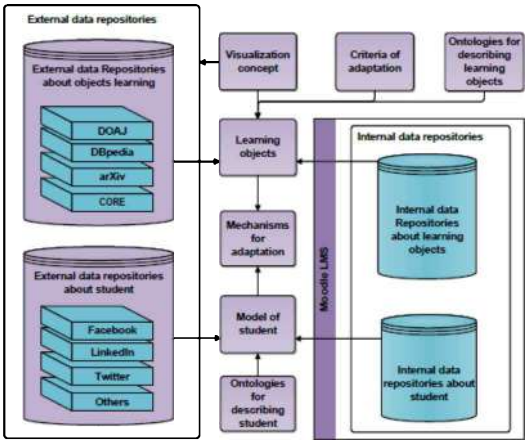


Figure 2: The main model elements

The architecture of the proposed model is shown in Fig. 1. It includes the following components: learning objects (metadata, annotation and semantic content enrichment), the student's model (static and dynamic data on the student), ontology (ontology for describing learning objects and ontologies to describe students) and criteria of adaptation (Felder – Silverman learning styles model). The figure 2. shows the main model elements.

The proposed model is based on the next procedure: The initial step in the procedure is student Interface. It is the communication component that controls the interaction between the student and the system. It deals with the user account data (such as registration and login). After this step, student will answer learning style questionnaire related to FSLSM model. If student logs into the Moodle for the first time, he will need to fill Felder Silverman Questonary, if not, his learning style will be already available in the system. Real time monitoring of the activities of students in the system and the use of learning objects will be executed by Moodle, and forwarded to Jena. D2RQ server is responsible for transforming Moodle MySQL relational database into a semantic database that is organized in tables. The next stage is creating ontology in Protégé 5.0.0.beta version. In this stage, the system compares the outcomes from questionnaire to these from the reference ontology using inference rules (association rules). Subsequently, it starts to recommend adaptive content based on the personalization. The result is transfered to Jena Semantic Framework. Jena enables implementation of the semantic web recommendations (Carroll et al., 2004). Dynamically reasoning over the semantic data is done by Pellet. Base SWRL rules defined in the ontology and rules defined in the Pellet receive the recommendations in which way learning objects should be personalized. Through this, aaccording to student's learning style, appropriate contet will be displayed to him. The inference engine is the crucial component for constructing adaptive learning. It includes comparing recommendation agent and updating agent that provide personalized student profile dynamically. Whenever new information is available, it will be sent to the inference engine, which functionality is based on rule-based reasoning. Jena returns results of the semantic reasoning to Moodle by connecting with OWL and PHP API. This procedure requires several web services for implementation.

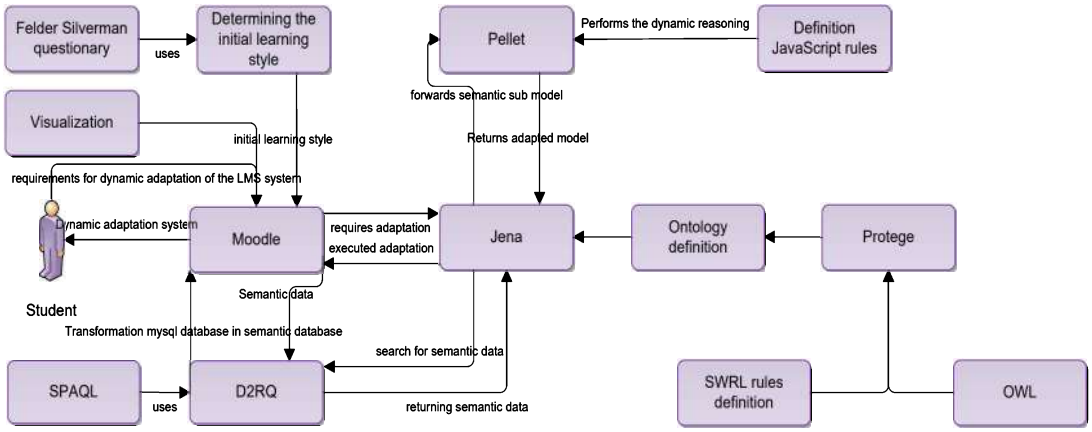


Figure 3: The proposed procedure for adaptive e-learning systems

.

3.1. Creating semantic elements in moodle

Three plug-in blocks and two web services were implemented in the Moodle platform for the purpose of this research (figure 4):

- MAU (Moodle Adaptive Learning) block where for each student initial learning style according to the Felder Silverman questionnaire is defined. During the time, the student's learning style can be changed.
- MAU resource block for resource classification based on learning style.
- MAU visualization block (Recommended resources button available for each week) for visual representation of semantic enriched resources. It contains an internal educational resource from Moodle and resources are recommended to students according to their learning style from three semantic academic repositories: DBPedia, Directory of open access Journal (DOAJ), arXiv I COnnecting REpositories (CORE).
- Web service that monitors the behavior of students in Moodle in real time. The task of this web service is to monitor how much and how often student performs some actions and activities with educational resources.
  - Web service FB app that monitors the students' activities on Facebook. The reason for this is to follow with greater precision if he belongs to a particular learning style. This web service is done by connecting Facebook and Moodle API. Jena combines all of the API calls.

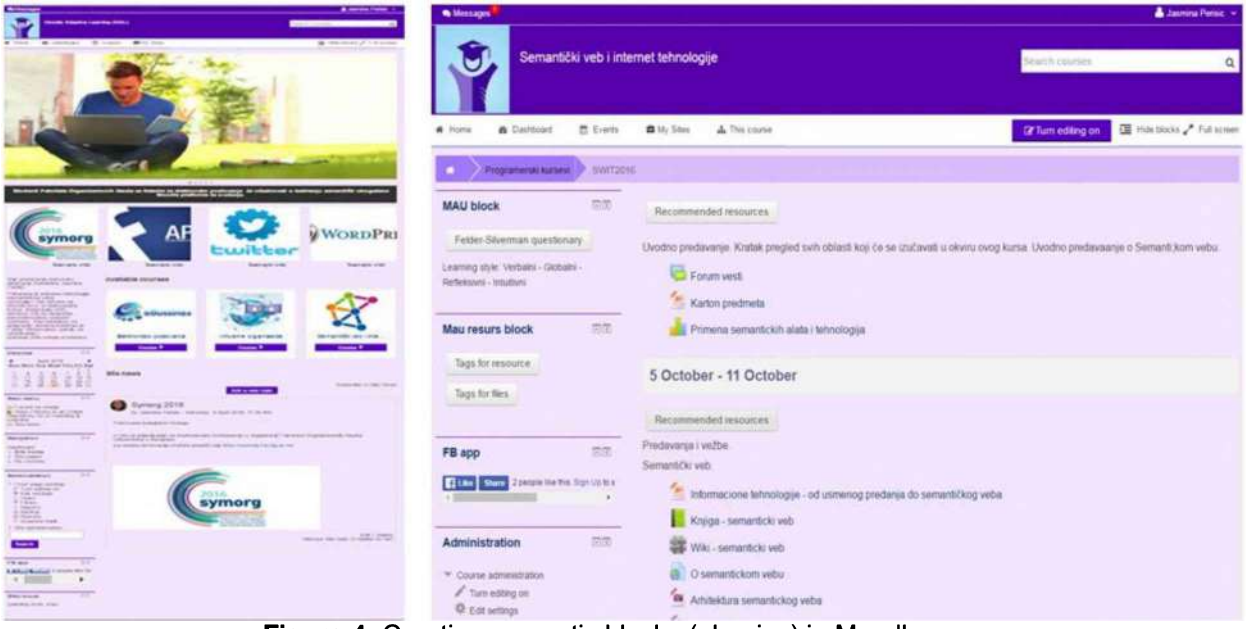


Figure 4: Creating semantic blocks (plug-ins) in Moodle

3.2. Moodle data semantic mapping

The process of translating relational database into semantic can be made using D2RQ platform (figure 5). The D2RQ Platform consists of:

- The D2RQ Mapping Language - a declarative mapping language for describing the relation between an ontology and a relational data model. Mapping of one table from Moodle represents one class in D2RQ Mapping Language.
- The D2RQ Engine - a plug-in for the Jena Semantic Web toolkit that uses the mappings to rewrite Jena API calls to SQL queries over the database and passes query results up to the higher layers of the frameworks.
- D2R Server - an HTTP server that provides a Linked Data view, an HTML view for debugging and a SPARQL Protocol endpoint over the database.

Figure 5: Moodle mapping classes (dataset)

The figure 6. shows D2RQ Engine Moodle classes. Actually, it represents a SPARQL endpoint for our Moodle dataset mapping. So, we can execute some SPARQL queries for mapping classes and properties. The result of the SPARQL queries can be used by Jena in JSON or XML syntax.

Figure 6: D2RQ Engine Moodle classes

The figure 7. shows the source code from Moodle relational database server D2RQ that is mapped using the semantic database with the default prefix *vocab* replaced with the prefix of our ontology *mau*. The D2RQ generic code has Tirttle syntax.

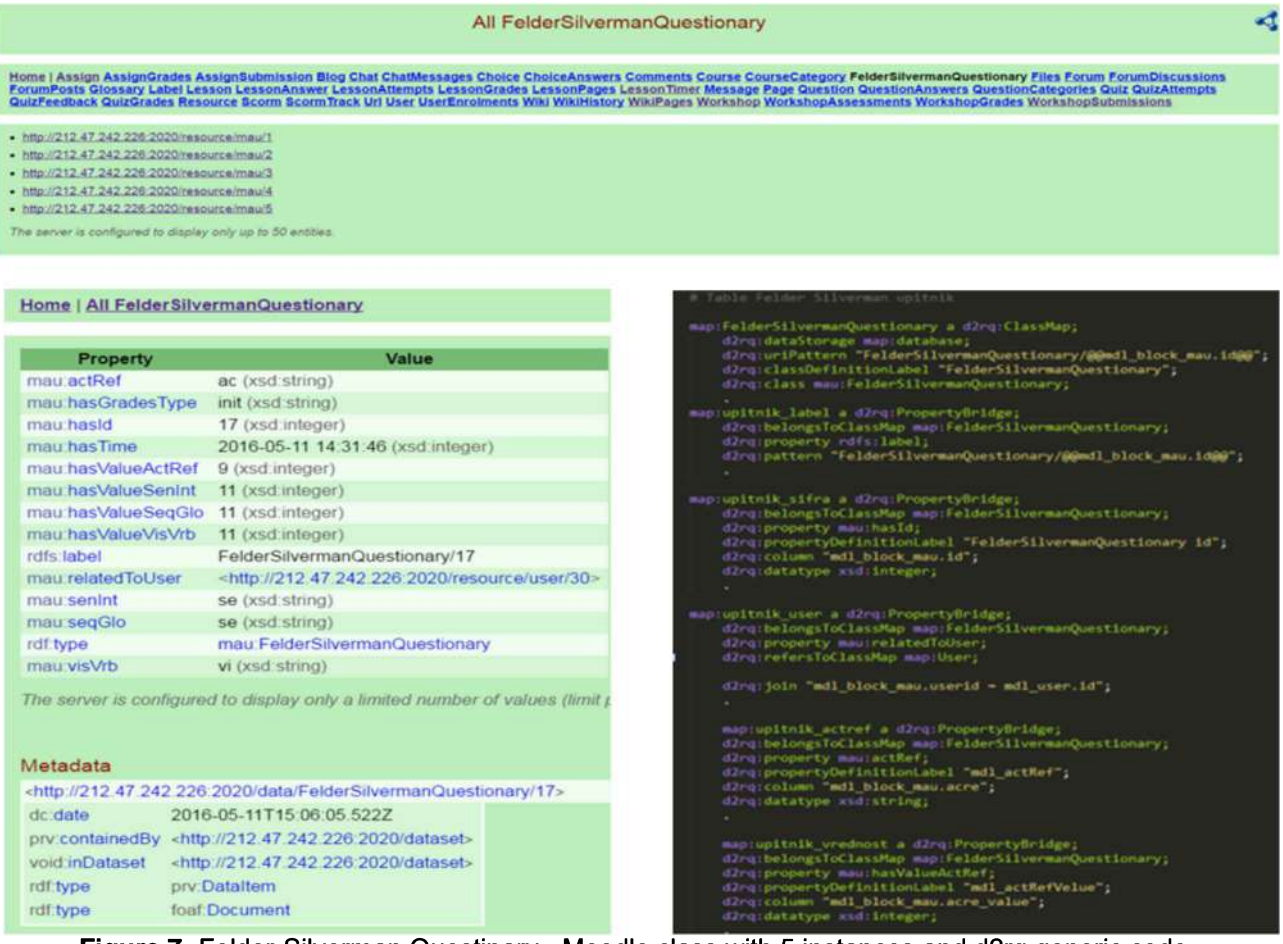


Figure 7: Felder-Silverman Questinary - Moodle class with 5 instances and d2rq generic code

3.3. Creating a domain ontology in Protégé and SWRL rules

Properly designed ontologies can accurately describe any domain, but caution needs to be exercised with balancing their expressiveness and complexity. For the purposes of this paper, it was necessary to partially take advantage of existing standards (vocabularies, ontologies) and use their classes and properties in the D2RQ mapping file (Fig. 8). For creating a student model, we used the basic FOAF ontology. For the modeling of learning objects, we used the basic Dublin Core and IEEE LOM ontologies. Those mapped Moodle data represent a good base for enriching of domain ontology and making more precise rules for personalized dynamic adaptive e-learning systems.

```
@prefix owl: <http://www.w3.org/2002/07/owl#> .
@prefix dc: <http://purl.org/dc/terms/#> .
@prefix mau: <http://mau.rs/Ver1.owl#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix foaf: <http://xmlns.com/foaf/0.1/#> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
@prefix d2rq: <http://www.wiwiss.fu-berlin.de/suhl/bizer/D2RQ/0.1#> .
@prefix jdbc: <http://d2rq.org/terms/jdbc/> .
@prefix lom: <http://mau.rs/LOM.owl#> .
```

Figure 8: Using existing ontologies for creating the domain ontology

Ontology and learning bases can be adjusted intuitively inside Protégé, being accessed with a graphical client interface and Java API. Protégé can be extended using pluggable components to include new functionalities and administration (Calvanese et al., 2015; Lohmann, Negru, Haag, & Ertl, 2014). We used this editor for ontology development because it enables the construction of domain ontologies and customized data entry forms. In addition, it allows the definition of classes, class hierarchies, variables, variable-value restrictions, and the relationships between classes as well as the properties of these relationships. The figure 9. shows list of clasees, data, object properties and instances in the created ontology.

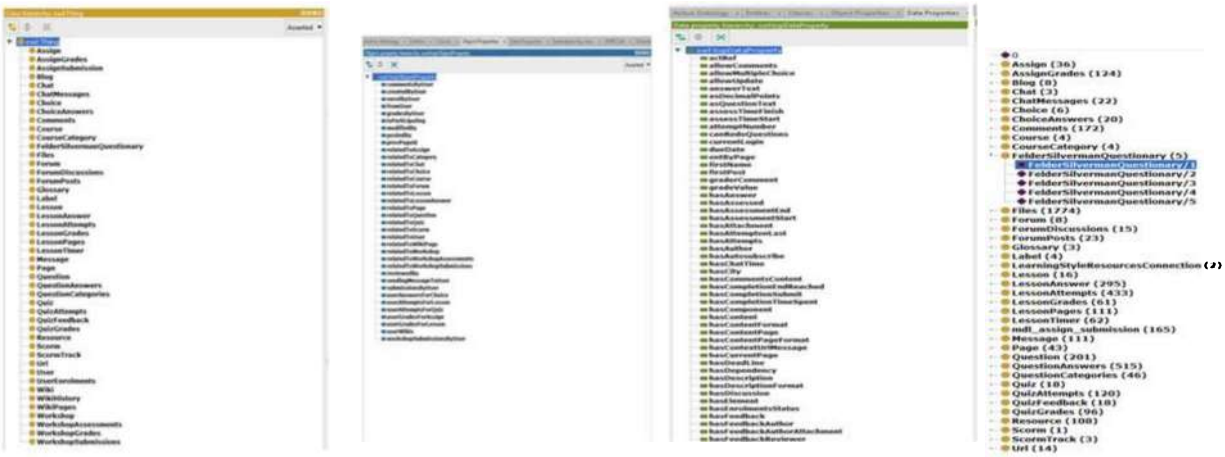


Figure 9: List of Classess, Object Properties, Data Properties and instances in MAU ontology

The first phase of the ontology building process is to identify the ontology, goal and scope, in order to specify the domain ontology and required resources. Figure 10. shows creation of simple adaptation rules which are defined with SWRL syntax. For instance, the Felder Silverman questionnaire class has an initial value of 0. Then we define SWRL rules for student's learning style classification after the questionnaire is completed. The student must belong to one learning style in one dimension. If the learning style changes over time, the student can move only his counterparts within the same dimension.

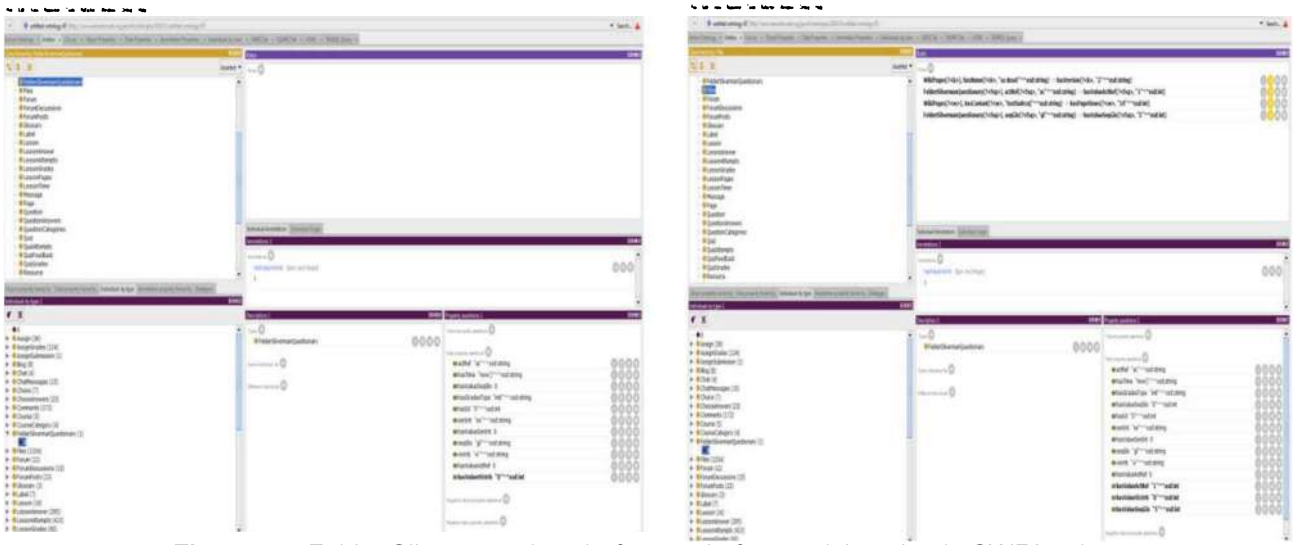


Figure 10: Felder Silverman class before and after applying simple SWRL rules

Rule 1: FelderSilvermanQuestionary (?fsq) ^ seqGlo(?fsq, "gl"^^xsd:string) → hasValueSeqGlo(?fsq, 5)
Rule 2: FelderSilvermanQuestionary (?fsq) ^ actRef(?fsq, "ac"^^xsd:string) → hasValueActRef(?fsq, 1)
Rule 3: WikiPages(?k) ^ hasName(?k, "sa deset") → hasVersion(?k, "2"^^xsd:string)
Rule 4: WikiPages(?w) ^ hasContent(?w, "testSadrzaj"^^xsd:string) → hasPageViews(?w, 10)

The first two rules are related to the Felder-Silverman questionnaire and the other two to WikiPages. Rules execute sequentially. Values that belong to the class of individuals and values returned to the set of SWRL rules are shown in the Individual Description and Individual Property fields. Creation and execution of SWRL rules are executed in Protege SWRL Tab.

4. CONCLUSION

Learning Management Systems have demonstrated to be a useful tool in learning processes, especially for online students, and they are implemented in most universities worldwide. In this paper, we propose a new semantic model for creating dataset and ontology model for adaptation in e-learning systems. It is based on real behavior patterns of students during interaction with the Moodle LMS and social networks. Those patterns involve the use of ontologies, semantic technologies and adaptation rules according to the personalization with a FSLSM model in real time. An advantage of this proposed model is that if the metadata model changes in the dataset and ontology, then, all semantic plug-ins in LMS that use this ontology as a reference model will change their behavior without changing its code.Future work will focus on extending our ontology to other metadata standards and external vocabularies. Also, in the future we will try to extend the criteria of adaptation to some other student preferences.

ACKNOWLEDGEMENT

The authors are thankful to the Ministry of Education and Science for financial support grant number 174031.

REFERENCES

Ainin, S., Naqshbandi, M. M., Moghavvemi, S., & Jaafar, N. I. (2015). Facebook usage, socialization and academic performance. *Computers and Education*, *83*, 64–73. http://doi.org/10.1016/j.compedu.2014.12.018

Arch-Int, N., & Arch-Int, S. (2013). Semantic Ontology Mapping for Interoperability of Learning Resource Systems using a rule-based reasoning approach. *Expert Systems with Applications*, *40*(18), 7428–7443. http://doi.org/10.1016/j.eswa.2013.07.027

Bakkas, J., & Bahaj, M. (2013). Generating of RDF graph from a relational database using Jena API. *International Journal of Engineering and Technology*, *5*(2), 1970–1975.

Bäumer, F. S., Gim, J., Jeong, D.-H., Geierhos, M., & Jung, H. (2014). Linked open data system for scientific data sets. *CEUR Workshop Proceedings*, *1292* (April 2016).

Begam, M. F., & Ganapathy, G. (2013). Adaptive Learning Management System Using Semantic Web Technologies. *International Journal on Soft Computing*, *4*(1), 1–8. http://doi.org/10.5121/ijsc.2013.4101

Brusilovsky, P. (2012). Adaptive Hypermedia for Education and Training. *Adaptive Technologies for Training and Education*, 46–65. http://doi.org/10.1007/BF00143964

Calvanese, D., Cogrel, B., Komla-ebri, S., Kontchakov, R., & Lanti, D. (2015). Ontop : Answering SPARQL Queries over Relational Databases. *Semantic Web Journal*.

Caputi, V., & Garrido, A. (2015). Student-oriented planning of e-learning contents for Moodle. *Journal of Network and Computer Applications*, *53*, 115–127. http://doi.org/10.1016/j.jnca.2015.04.001

Carroll, J. J., Dickinson, I., Dollin, C., Reynolds, D., Seaborne, A., & Wilkinson, K. (2004). Jena: Implementing the Semantic Web Recommendations. *Proceedings of the 13th International World Wide Web Conference on Alternate Track Papers & Posters - WWW Alt. '04*, 74–83. http://doi.org/10.1145/1013367.1013381

Chen, Y. J., Chu, H. C., Chen, Y. M., & Chao, C. Y. (2013). Adapting domain ontology for personalized knowledge search and recommendation. *Information and Management*, *50*(6), 285–303. http://doi.org/10.1016/j.im.2013.05.001

Conde, M. Á., García, F. J., Casany, M. J., & Alier, M. (2010). Applying web services to define open learning environments. In *Proceedings - 21st International Workshop on Database and Expert Systems Applications, DEXA 2010*, 79–83. http://doi.org/10.1109/DEXA.2010.36

Despotović-Zrakić, M., Marković, A., Bogdanović, Z., Barać, D., & Krčo, S. (2012). Providing Adaptivity in Moodle LMS Courses. *Educational Technology & Society*, *15*(1), 326–338.

Dorça, F. A., Lima, L. V, Fernandes, M. A., & Lopes, C. R. (2013). Comparing strategies for modeling students learning styles through reinforcement learning in adaptive and intelligent educational systems:

An experimental analysis. *Expert Systems with Applications*, *40*(6), 2092–2101. http://doi.org/10.1016/j.eswa.2012.10.014
Essalmi, F., Ayed, L. J. Ben, Jemni, M., & Graf, S. (2015). Generalized metrics for the analysis of E-learning personalization strategies. *Computers in Human Behavior*, *48*, 310–322. http://doi.org/10.1016/j.chb.2014.12.050
Felder, R., & Silverman, L. (1988). Learning and teaching styles in engineering education. *Engineering Education*, *78*(June), 674–681. http://doi.org/10.1109/FIE.2008.4720326
Gruber, T. R. (1993). A translation approach to portable ontology specifications. *Knowledge Acquisition*, *5*(2), 199–220. http://doi.org/10.1.1.101.7493
Hassanpour, S., O'Connor, M. J., & Das, A. K. (2010). Visualizing logical dependencies in SWRL rule bases. In *Semantic Web Rules*, 259–272. http://doi.org/10.1007/978-3-642-16289-3-22
Horridge, M., & Bechhofer, S. (2011). The OWL API: A Java API for OWL ontologies. *Semantic Web*, *2*(1), 11–21. http://doi.org/10.3233/SW-2011-0025
Hsu, I. (2012). Intelligent Discovery for Learning Objects Using Semantic Web Technologies. *Educational Technology & Society*, *15*, 298–312.
IEEE Learning Technology Standards Committee. (2002, July). Draft standard for learning object metadata. Institute of Electrical and Electronics Engineers, Inc.
Kurilovas, E., Kubilinskiene, S., & Dagiene, V. (2014). Web 3.0 - Based personalisation of learning objects in virtual learning environments. *Computers in Human Behavior*, *30*, 654–662. http://doi.org/10.1016/j.chb.2013.07.039
Lohmann, S., Negru, S., Haag, F., & Ertl, T. (2014). VOWL 2: User-Oriented Visualization of Ontologies. *Knowledge Engineering and Knowledge Management - 19th International Conference, {EKAW} 2014, Link{ö}ping, Sweden, November 24-28, 2014. Proceedings*, *8876*, 266–281. http://doi.org/10.1007/978-3-319-13704-9_21
Malviya, N., Mishra, N., & Sahu, S. (2011). Developing University Ontology using protege OWL Tool: Process and Reasoning. *International Journal of Scientific & Engineering Research*, *2*(9), 1–8. Retrieved from http://www.ijser.org/researchpaper/developing{}{_}{}university{}{_}{}ontology.pdf
Manasijević, D., Živković, D., Arsić, S., & Milošević, I. (2016). Exploring students' purposes of usage and educational usage of Facebook. *Computers in Human Behavior*, *60*, 441–450. http://doi.org/10.1016/j.chb.2016.02.087
Nafea, S., Maglaras, L., Siewe, F., Smith, R., & Janicke, H. (2016). Personalized Students' Profile Based on Ontology and Rule-based Reasoning. *ICST Transactions*. Retrieved from http://hdl.handle.net/2086/11693
Popescu, E. (2009). Diagnosing students learning style in an educational hypermedia system. *Cognitive and Emotional Processes in Web-Based Education: Integrating Human Factors and Personalization. Advances in Web-Based Learning Book Series, IGI Global*, (13), 187–208.
Qureshi, I. A., Raza, H., & Whitty, M. (2014). Facebook as e-learning tool for higher education institutes. *Knowledge Management and E-Learning*, *6*(4), 440–448.
Qwaider, W. Q. (2012). Semantic Web Technologies Applied to E-Learning System. *International Journal of Computer Applications*, *47*(10), 12–17. http://doi.org/10.5120/7223-0053
Rezgui, K., Mhiri, H., & Ghédira, K. (2014). Extending Moodle Functionalities with Ontology-based Competency Management. *Procedia Computer Science*, *35*, 570–579. http://doi.org/10.1016/j.procs.2014.08.138
Sheeba, T., Begum, S., & Bernard, M. (2012). Semantic Web to E-Learning Content. *International Journal*, *2*(10), 58–66. Retrieved from http://www.ijarcsse.com/docs/papers/10{_}October2012/Volume{_}2{_}issue{_}10{_}October2012/V2I10-0039.pdf
Sirin, E., Parsia, B., Grau, B. C., Kalyanpur, A., & Katz, Y. (2007). Pellet: A practical OWL-DL reasoner. *Web Semantics*, *5*(2), 51–53. http://doi.org/10.1016/j.websem.2007.03.004
Somyürek, S. (2015). The New Trends in Adaptive Educational Hypermedia Systems. *International Review of Research in Open and Distributed Learning*, *16*(1), 221–241.
Vicient, C., Sánchez, D., & Moreno, A. (2013). An automatic approach for ontology-based feature extraction from heterogeneous textual resources. *Engineering Applications of Artificial Intelligence*, *26*(3), 1092–1106. http://doi.org/10.1016/j.engappai.2012.08.002
Yunianta, A., Yusof, N., Jayadianti, H., Othman, M. S., & Suhaimi, S. (2014). Ontology Development to Handle Semantic Relationship between Moodle E-learning and Question Bank System. In T. Herawan, R. Ghazali, & M. M. Deris (Eds.), *Recent Advances on Soft Computing and Data Mining* (Proceeding, 691–701. Cham: Springer International Publishing. http://doi.org/10.1007/978-3-319-07692-8_65

SUCCESS FACTORS FOR LUXURY BRANDS IN E-BUSINESS: BURBERRY CASE STUDY

Tijana Radisavljevic*[1], Aleksandar Markovic[1]
[1]Faculty of organizational sciences, University of Belgrade
*Corresponding author, e-mail: tijanafon.radisavljevic@yahoo.com

***Abstract**: The most of brands in luxury fashion industry are resistant to adopting e-business due to certain characteristics of Internet that are threatening to diminish luxury brand exclusivity. However, many researches showed that e-commerce could bring new opportunities of increasing markets for luxury goods. Thus, the question is no longer whether luxury brands should go online, but what is the best strategy to do it. Hence, the aim of this paper is to identify best practices and define conceptual model that provide guidance to the companies entering digital world. Based on analysis of Burberry's digital strategy, as the company with the highest digital IG, recognized, this study presents some of critical success factors on luxury fashion e-business.*

***Keywords:** e-commerce, digitalisation, luxury, brands, burberry, online, strategy*

1. INTRODUCTION

E-commerce is an inevitable trend as consumers purchase more products and services through online channels (Kotler & Keller, 2009). Chaffey (2015) reports that more than 40% of the World population is using the Internet and Forte (2014) predicts that online market will reach $ 1.4 billion, which is 14% more than in 2012. Yet, there are still companies, mainly from luxury fashion industry, that are wittingly avoiding the implementation of e-business into their strategy. The underlying reason for it is belief that Internet characteristics will diminish exclusivity and value of the luxury brand. However, statistical data and other researches showed that Internet has major influence on luxury shoppers as well that carefully designed e-strategy can help luxury companies to benefit from online presence and involvement (Mau, 2015). Moreover, Bain & Company (2014, p.17) said in their report that online luxury market multiplied 12 times in the past 11 years composing now 5% of total sales.

Concepts of luxury and Internet, at first site, are carrying opposite ideas. While luxury is related to the ideas of originality, creativity, precision, focus on details, emotions, exclusivity, prestige, high prices, high quality and very narrow target group, Internet is related to mass accessibility and availability as well as low price (Okonkwo, 2010). There is 35% of luxury brands, among which are Chanel, Dior, Celine, Hermes, that used these contrasts as the excuse for not integrating the online business into their strategy (Bain & Company, 2014, p.17; Mau, 2015). Even though this excuse may seem reasonable, statistical reports and other researches showed digital technology is part of everyday life of luxury consumers, as well that there are many examples of the luxury fashion companies (such as Burberry, Gucci or Ralph Lauren) that successfully implemented online strategy and benefited from it (Choi et al., 2014; Galloway, 2013).

Digital technology is important when it comes to two-way communication between company and customers. Companies are using digital technology to interact with their customers in order to gain insightful feedback, while customers are using it to create communities and share experiences (Euromonitor, 2013). Moreover, McKinsey&Company (2015) reports that three out of four luxury shopping are influenced by online experience, even though they are done offline. Moreover, digital interaction between consumers and luxury brands is directly increasing the offline sale for 13% and overall sale for 20% (McKinsey&Company, 2013). Not only online experience influences the offline shopping but demand for online luxury products is on constant growth (Okonkwo, 2010). Furthermore, unlike the offline sale growing only 7% a year, online sale grows 27% a year. Despite the fact that Internet cannot offer the prestigious locations, atmosphere, smell and touch that luxury products put forward, Okonkwo (2010) states that modern technology has made it possible to develop, adapt and apply e-business strategies that will enable luxury to thrive on the Internet without compromising its innate qualities and unique philosophy. Burberry was named the company with the highest digital IQ when it comes to Luxury Industry (Galloway, 2013), hence this paper aims to determine patterns and define common conceptual benchmark model that could help other luxury brands to implement their e-strategy.

Companies in luxury fashion industry are lagged behind adopting e-commerce due to some difficulties of maintaining brand image while being present online. However, e-commerce could bring new opportunities of increasing the size of luxury goods market. Thus, the issue of 'why' luxury should be online is no longer relevant but the current challenge is 'how' luxury should position itself online, particularly as consumers take charge of their online experiences. Based on in-depth analysis of Burberry, recognized as a digital innovation leader in luxury industry, this study presents some of critical success factors on luxury fashion e-commerce.

2. ELECTRONIC BUSINESS

Electronic business (e-business) is often thought to refer to buying and selling using the Internet, however, it involves much more than online financial transactions between two parties. Adoption of e-business is driven by benefits it brings to various parts of the organization, depending on the orientation of e-business (Chaffey, 2009; Okonkwo, 2010).

E-business represents "all electronically mediated information exchanges, both within an organization and with external stakeholders supporting the range of business processes" (Chaffey, 2009, p.13). Thus, e-business includes "online communications, client relationship management, consumer monitoring, Internet marketing, experiential marketing, branding, retail, logistics and their connected dimensions like merchandizing and after-sales support" (Okonkwo, 2010, p.20).

When evaluating the strategic impact of e-business on an organization, it is useful to identify the orientation of e-commerce, whether it is sell-side or buy-side, as well as the benefits in terms of increased revenue and/or reduced costs (Chaffey, 2009). Electronic commerce, defined as "all electronically mediated information exchanges between an organization and its external stakeholders", on one hand has its buy-side whereby transactions are done between a purchasing organization and its suppliers and on the other, sell-side where transactions occur between a supplier organization and its customers (Chaffey, 2009, p.10). The focus of this study is the sell-side e-commerce, which has for a purpose to sell the products and/or services, provide necessary information, stimulate the purchase, and to build stronger brand image. Benefits arising out of these activities are reflected in decreased costs and/or increased revenues. While potential revenue growth is a result of larger customer base and encouraged loyalty, cost reduction is achieved by delivering services electronically whereby staff costs, transport costs, costs of materials and others are cut (Chaffey, 2009).

Electronic Business should be understood as an integrated approach to every aspect of online business with a purpose to continuously optimise a company's value proposition through adopting digital technology and the Internet as channels of multiple business activities.

2.1. Online Value Proposition Model

Online value proposition of a specific brand refers to the set of dimensions, which provide benefits for the customers and distinguish it from its competitors (Kotler and Armstrong, 2006; Sheth, Newman and Gross, 1991; Schultz and Zelezny, 1999). In order to conceptualise this topic, some scholars were focused on defining frameworks with key dimensions that would determine essential attributes for their business value proposition (Chaffey, 2009; Rayport and Jaworski, 2001; Rayport and Jaworski, 2003).

Schultz and Zelezny (1999) define values as beliefs that lead and evaluate the choices, outcomes and desirable behaviours. Considering the consumption when it comes to purchase, different types of values are what is directly driving customer choices (Sheth, Newman, and Gross, 1991). Accordingly, a value proposition was defined as "the set of benefits or values it promises to deliver to consumers to satisfy their needs" (Kotler and Armstrong, 2006, p. 9). It implies to customers how it will satisfy their needs better or differently from competitors ((Tsun-Yin) Tung, (Catherine) Jai and Davis Burns, 2014).

In order to provide a clear understanding of benefits for the customers, some academics proposed application of online value proposition models as a part of online strategy. Chaffey (2009, p.37) introduced the "6 Cs" model that consists of six different elements: content, customization, community, convenience, choice and cost reduction. Similarly, Rayport and Jaworski (2001, p.116) proposed "7 Cs" model that includes slightly different dimensions: context, content, customisation, community, communication, connection and commerce. Given the fact that this paper is focused on luxury industry where high prices of the products/services are one of the main characteristics, Chaffey's model of "6 Cs" is found to be less suitable for the specific scope of this study, thus the focus will be on "7 Cs" model:

- *Context* captures the aesthetic nature and functionality of the site, which have significant impact on consumer perception (Tsun-Yin) Tung, (Catherine) Jai and Davis Burns, 2014). Rayport and Jaworski (2001) defined Context as "the look-and-feel of a screen-to-face customer interface" (p. 11). In order to create a positive experience and influence on the customer, it is important to have highly organised linking structure between pages and important information easily visible (Chaffey, 2009; Lee and Benbasat, 2003).
- *Content* should be focused on what site delivers, comprising the mix of product and service (Lee and Benbasat, 2003). Rayport and Jaworski (2001) defined it as "all digital subject matter on the site" (p. 115). Content could be presented through combination of product and service information, interaction with the customers and multimedia support (Tsun-Yin) Tung, (Catherine) Jai and Davis Burns, 2014).
- *Community* deals with the interaction between the users including a sense of involvement and membership through which they share their opinions and experiences (Chaffey, 2009; Lee and Benbasat, 2003).
- *Customisation* refers to the site's ability to offer customised content and personalised interface based on the customer preferences (Chaffey, 2009; Lee and Benbasat, 2003). Rayport and Jaworski (2001) defined it as "the site's ability to tailor itself or to be tailored by each user" (p. 115). Customisation has two main concepts depending which side is the initiator of the customisation- tailoring is initiated by the firm and personalisation by the user. This feature is important part of online value proposition model as it is able to encourage consumer's shopping activities (Tsun-Yin) Tung, (Catherine) Jai and Davis Burns, 2014).
- *Communication* concerns "the dialogue that unfolds between the site and its user" (Rayport and Jaworski, 2001, p. 116), which can be both one-way information exchange, or interactive whereby communication flow would be two-sided (Lee and Benbasat, 2003; (Tsun-Yin) Tung, (Catherine) Jai and Davis Burns, 2014).

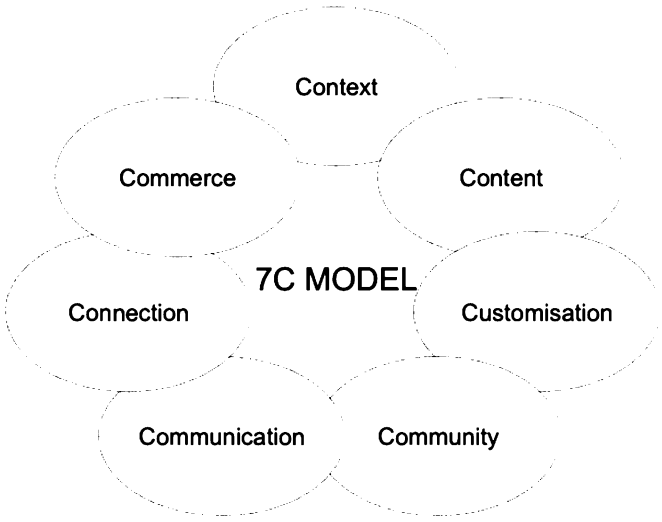


Figure 1: Seven Cs Model (Rayport i Jaworski, 2003)

- *Connection* is defined as "the extent of the formal linkages between the site and other sites" (Rayport and Jaworski, 2001, p. 116), which can create additional value for the customers (Lee and Benbasat, 2003; (Tsun-Yin) Tung, (Catherine) Jai and Davis Burns, 2014).
- *Commerce* involves various aspects of business transactions ssuch as "the sale of goods, products, or service on the site" (Rayport and Jaworski, 2001, p. 116), pre-sale and after-sale support, security, order tracking, delivery options, etc. (Lee and Benbasat, 2003; (Tsun-Yin) Tung, (Catherine) Jai and Davis Burns, 2014).

The purpose of the 7Cs framework is to show the importance of the seven dimensions when it comes to influencing consumer perception, creating value for them and meeting their needs in order to grow the business.

3. LUXURY INDUSTRY

Among the businesses currently present in the market, luxury business is, by far, one with most complexity and wide-range (Hoffmann and Coste-Manière, 2011). Fast- moving environment is bringing new challenges but as well opportunities for the companies.

Most people are able to recognise luxury products but cannot define the characteristics that contribute to the concept of luxury. Some define luxury by price, others by a list of attributes, and some by exclusivity of distribution (Hoffmann and Coste-Manière, 2013). Karoline Huber, cited in Boyden (n.d., p.8), explains, "Luxury is based on an emotion and it is people who create emotional differences. Competing on product provides less advantage – but using people as a competitive differentiator creates the emotional benefits that drive loyalty, protect brand value and build brand equity". What justifies the premium pricing of luxury goods is the value of a brand in the consumer minds. Brand value is created through stories, traditions, innovation, scarcity, differentiation and exclusivity (Dubois, Czellar and Laurent, 2005). Luxury goods are not used for their intrinsic value but for their symbolic value that for each individual can be different. Hence, it can be said that luxury product has two facets, tangible and intangible. Tangible aspect involves at first place product quality that is assured on all stages of supply chain. Furthermore, visible aspects include exceptional and scarce materials (components), expertise in manufacturing, craftsmanship heritage, original design and outstanding performance (Brun and Castelli, 2013). According to Herzberg's Motivation Theory (1959) tangible characteristic of luxury product would be dissatisfier, meaning that luxury consumers will naturally expect excellence in the product performance and quality. Luxury product must satisfy three criteria: it must have a strong artistic element, it must be the result of craftsmanship and it must have a global brand reputation (Hoffmann and Coste-Manière, 2011). Yet, what motivate the consumers to opt for luxury product are intangible facets of it, which include emotional appeal of specific luxury brand. Emotional appeal is driven by many intangible factors, such as global reputation of the brand, innovation, shopping experience, a lifestyle brand is proposing, exclusivity of product achieved by marketing approaches and premium prices (Brun and Castelli, 2013; de Azevedo Rosa, 2012).

The global luxury market is composed of nine different, yet complementary, segments presented in the Figure 2, whereby the focus of this study is Personal luxury goods. In 2014 the global luxury market

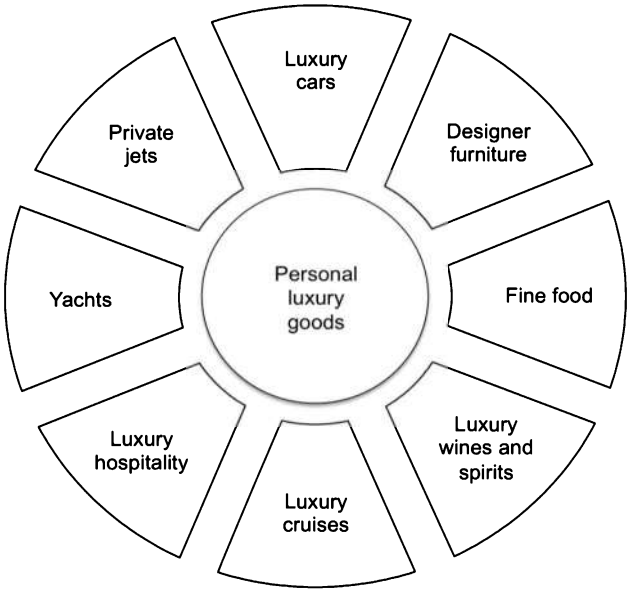


Figure 2: The nine segments of global luxury market (Adapted from: Bain & Company, 2014, p. 8)

exceeded €850 billion from which the personal luxury goods market generated more than €223 billion, which is for 3% higher than in the previous year (Bain & Company, 2014, p.8). Moreover, Bain & Company (2014, p.7) stated that the market of personal luxury goods tripled over the past 20 years and represents the "core of the core" of luxury.

All definitions and associations of luxury contain concepts of power, distinction, excellence, beauty, sophistication, superiority, class, privilege, rarity and exclusivity (de Azevedo Rosa, 2012). Luxury brand industry comprises exclusive group of brands across different product segments, whereby luxury brands differ from non-luxury brands according to functional and symbolic dimensions of the product as well as consumer perceptions of luxuriousness (Seo and Buchanan-Oliver, 2015).

3.1. Luxury Value Proposition Model (Offline)

Following the comprehensive understanding of all factors that build a luxury brand, Wiedmann, Hennigs and Siebels (2009, p.4) proposed a single model that includes "all relevant present and potential value sources of

the consumer's luxury perception". Drawing on existing luxury research theory, Wiedmann, Hennigs and Siebels (2009) defined the model with the four different dimensions and its variables (Figure 3) through which customers perceive the value of luxury product and/or service.

Financial Value represents the necessary element when it comes to luxury goods and it refers to the monetary aspects of the product or service in terms of price, discount, investment, etc. However, it is important to emphasise that in case of luxury goods qualitative characteristic are more important than quantitative. Accompanying the Financial Value, Price Value is positively correlated with high quality suggesting the sense of prestige and social status, which makes a product more desirable (Hennigs, Wiedmann and Klarmann, 2012; Wiedmann, Hennigs and Siebels, 2009).

Functional Value refers the essence of the luxury good, its purpose and core benefit. This dimension refers to the visible elements of a luxury good such as rare resources and materials, tradition, unique craftsmanship, original design and excellence in performance. Functional value is driven by usability, quality and uniqueness. Usability Value refers to both the product functionality and customer needs that will be satisfied with the product functionality. Thus, customers expect the item they purchase to perform and look as expected. Quality Value is related to the superior quality as the reason why customers opt for luxury

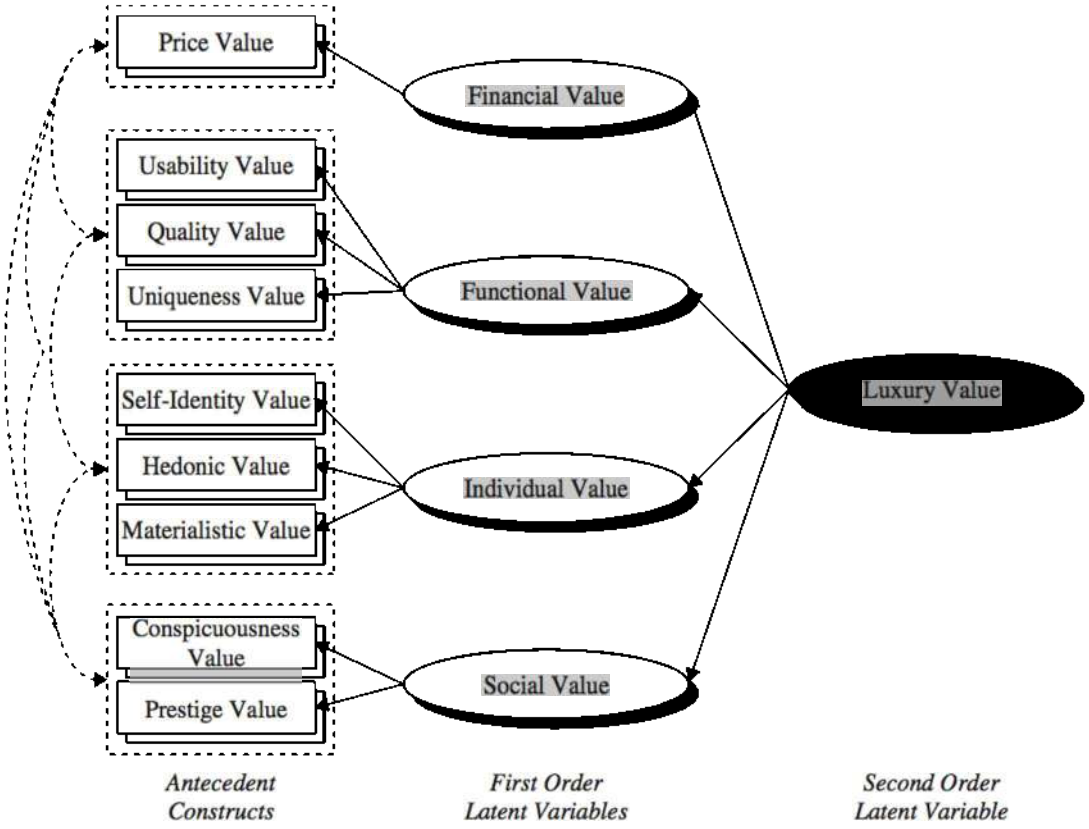


Figure 3: Conceptual Model: Determinants of Consumers' Luxury Value Perceptions (Adapted from: Wiedmann, Hennigs and Siebels, 2009, p.629, fig. 1)

goods as well to the assumption that luxury brand offers "greater product quality and performance than non-luxury brands" (Wiedmann, Hennigs and Siebels, 2009, p.630).

Individual Value of Luxury Value Perception has to do with consumer's personal preferences when it comes to luxury consumption. It addresses personal matters such as Self-Identity Value, Hedonic Value and Materialistic Value. Self-Identity Value is related to the research that showed some people opt for luxury brands in order to identify themselves with the symbols of luxury, such as exclusivity, authenticity, high quality, uniqueness, etc. Hedonic Value explains the intangible benefits of luxury goods that are creating emotional value, pleasure and excitement for the consumers. Materialistic Value represents the consumers' need to posses and acquire luxury goods in order to impress the social environment and position themselves highly in the society (Hennigs, Wiedmann and Klarmann, 2012; Wiedmann, Hennigs and Siebels, 2009).

Social Value is refers to the strong social function the consumption of luxury goods has for individuals. It represents the perceived utility in terms of conspicuousness and prestige value that luxury goods

consumption brings to the individuals within the their social groups. Conspicuousness Value is important to individuals who seek the social status and representation. Bearden and Etzel, cited in Wiedmann, Hennigs and Siebels (2009, p.632) concluded that "luxury goods consumed in public were more likely to be conspicuous goods than privately consumed luxury goods and that conspicuous consumption still plays a significant part in shaping preferences for many products that are purchased or consumed in public contexts". Prestige Value serves as the symbolic sign of elite group affiliation that will distinguish them from the no affluent lifestyles (Hennigs, Wiedmann and Klarmann, 2012; Wiedmann, Hennigs and Siebels, 2009). The key to creating successful strategy, including taking up online space, understands all relevant facts of consumer perception of luxury. The four proposed values and their antecedent constructs encompass consumer values that justify luxury purchase and represent prerequisite for successfully deployed online strategy.

3.2. Online Luxury Value Proposition Model

The Internet has played important role in the global market by enabling consumers not only to have an insight in the latest trends worldwide but also to shop worldwide (Deloitte, 2014a). Due to current trends in the market, the four-dimension model of luxury value proposition is extended through additional components related to e-business (Hennings, Wiedmann and Klarmann, 2012).

The latest trends like the market globalisation, digital technology, the Internet, democratisation of luxury and an increase in number of wealthy individuals are requiring from companies not only to adjust their strategies to the newest trends but also to change their perception of luxury as phenomenon (Radisavljević, n.d., p.10). Globalisation, as very popular trend lately, represents the integration of global market through social, economical, cultural, technological exchanges. Additionally, the Internet enabled a comprehensive availability, which led to assimilation of luxury preferences regardless cultural differences. One more consequence of these trends is the "democratisation of luxury" which refers to the fact that exclusivity got replaced by mass accessibility (Deloitte, 2014a, p.10). Furthermore, Okonkwo (2010) stated that online demand for luxury goods is on constant increase and influencing the growth of offline sales for 13% (McKinsey&Company, 2013, p.1). In addition, Bain & Company (2014, p.17) reported that in the last 11 years online luxury market multiplied 12 times and now accounts for 5% of total sales.

The refusal to accept the Internet as a complement to offline retailing and the inability to innovate is one of the biggest threats for luxury brands today. Luxury brands are finding justification in the adversarial relationship between the luxury and the Internet. While luxury nourishes tradition and exclusivity, Internet is quite an opposite. Even though many luxury brands are still hesitating to going online, this paper examines the power of the Internet as an instrument to reach a global audience while still maintaining a sense of exclusivity and sensory experience (Hennings, Wiedmann and Klarmann, 2012; Okonkwo, 2010).

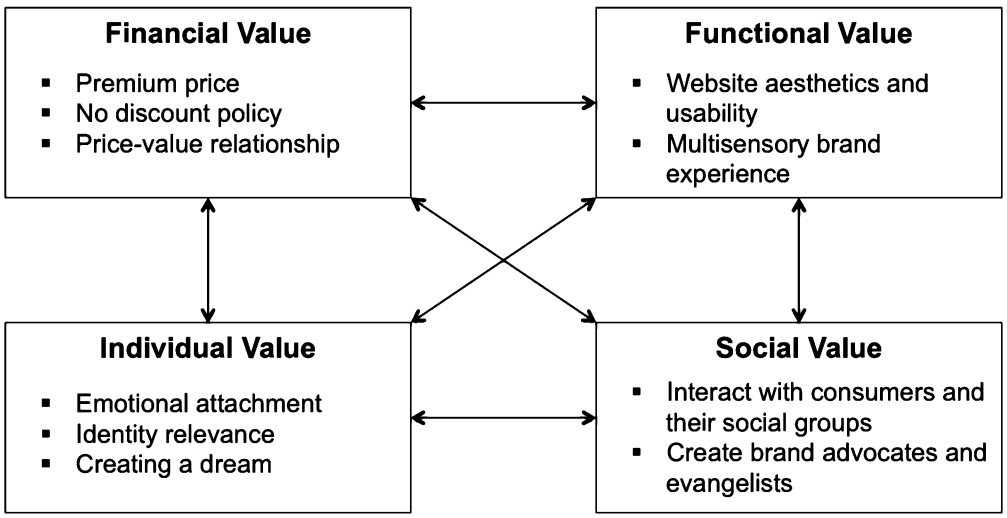


Figure 4: Online Luxury Value Proposition Model (Adapted from: Hennings, Wiedmann and Klarmann, 2012, p.34, fig.2)

With reference to the above-mentioned value dimensions, leaders in online luxury also incorporate the aspects that have to be addressed in luxury online business as illustrated in the Figure 4 and described in the following paragraphs.

Financial value. Despite the fact that a high price is widely accepted as a key component of luxury goods, it is important to point out that nature of luxury is qualitative and not quantitative. Hence, the price–value relationship is crucial, especially because the consumption of luxury products should provide social and psychological enhancements (Okonkwo 2010). In order to prevent potential diminishment of luxury goods in the virtual environment, the price premium associated with uniqueness, exclusivity, superb quality, hand-made craftsmanship, and impeccable service needs to be ensured in the virtual environment via limited distribution (Hennings, Wiedmann and Klarmann, 2012).

Functional value. Besides product-related characteristics that create value for luxury customers, the functional value of luxury in the virtual environment refers to the usability, quality and uniqueness of the online appearance when using the website and other applications. Even though the senses of touch and smell are missing, the digital technologies can leverage movement, music, texture, space and community to successfully regenerate a brand‘s philosophy online. Luxury brand managers should go beyond aesthetics and create marketing products that add value for the customer in terms of entertainment, education and engagement with the brand (Hennings, Wiedmann and Klarmann, 2012).

Individual value. Individuals use the luxury goods to support their identity projects and satisfy emotional needs, which represents the key elements in defining the concept of luxury. Customers experience luxuries as symbolic resources to transfer the brand's social symbolism, such as exclusivity, authenticity, quality, uniqueness and culture, into their own aspired identities. Therefore, with regard to the individual value of luxury, luxury brands should transfer the offline image into the online appearance and involve customers with the brand at a deeper level using the opportunity to gain feedback and make adjustments accordingly (Hennings, Wiedmann and Klarmann, 2012).

Social value. The social dimension of luxury addresses the social groups and focuses on online social networks. A lot of wealthy Internet users are regularly using social media becoming potential brand advocates. Customers broadcast their association with luxury brands within their social circles in order to relate brand's characteristics with their individual profiles, whereby they simultaneously promote the brand. Thus, by using the appropriate strategy, brands can become a part of the customer's online identity and vice versa.

The luxury companies can apply these four value dimensions with differing priorities, depending on their strategy for communicating their luxury message online. Researches have shown the opposite of what majority of luxury brands have thought (Hennigs, Wiedmann and Klarmann, 2012; Okonkwo, 2010; Radisavljevic, n.d.). The well-defined online strategy is crucial for luxury brands as it is not weakening, but strengthening the brand. The digital environment offers the opportunity to reach billions of people internationally, thus brands have to integrate their philosophy into online world in order to stay relevant and desirable for current and future customers (Hennings, Wiedmann and Klarmann, 2012).

Best practices give evidence that the key value dimensions of a luxury brand's offline strategy are a useful basis for the development of complementary online strategy that can create a true luxury experience. Further, this paper will examine the Burberry's best practice.

4. FINDINGS- A HOLISTIC LUXURY VALUE PROPOSITION MODEL

Given the above mentioned it could be concluded that in luxury industry online values cannot be created without the successful offline strategy. Likewise, researches showed that due to latest trends, it is not enough for luxury brands to propose only offline values but they need to adopt online strategy and reach their target group in virtual environment (Okonkwo, 2010). Thus, this study is proposing a holistic approach to creating a value for luxury customers.

The model presented in the Figure 5 integrates the both online and offline Luxury Value Proposition models with the 7Cs model. The integration of these three models is reflected in the correlation and overlapping between 7Cs' element Commerce with Financial Value, elements Communication, Content, Context with Functional Value, element Customisation with Individual value and elements Connection and Community with Social Value.

This model and the relationship of its elements can be explained the best through Herzberg's motivation theory (Herzberg, 1959). In order to succeed in digital environment, firstly it is necessary to have the values successfully implemented so that luxury brand will have well-established philosophy, story and tradition. If these elements are not well designed, they will diminish the luxuriousness of the goods. However, they are not enough to succeed digitally. In order for customer to buy a luxury product online the next step will be

implementation of online luxury values that are aligned with 7Cs model as presented in the Figure 5. Similarly, Abrams Research (n.d., p.6) are suggesting the five steps for business digitalisation: translate unique brand elements to social platforms, adapt business practices to the online business model, identify and expand audiences, empower customers and manage customer relations. Challenges that arise here are

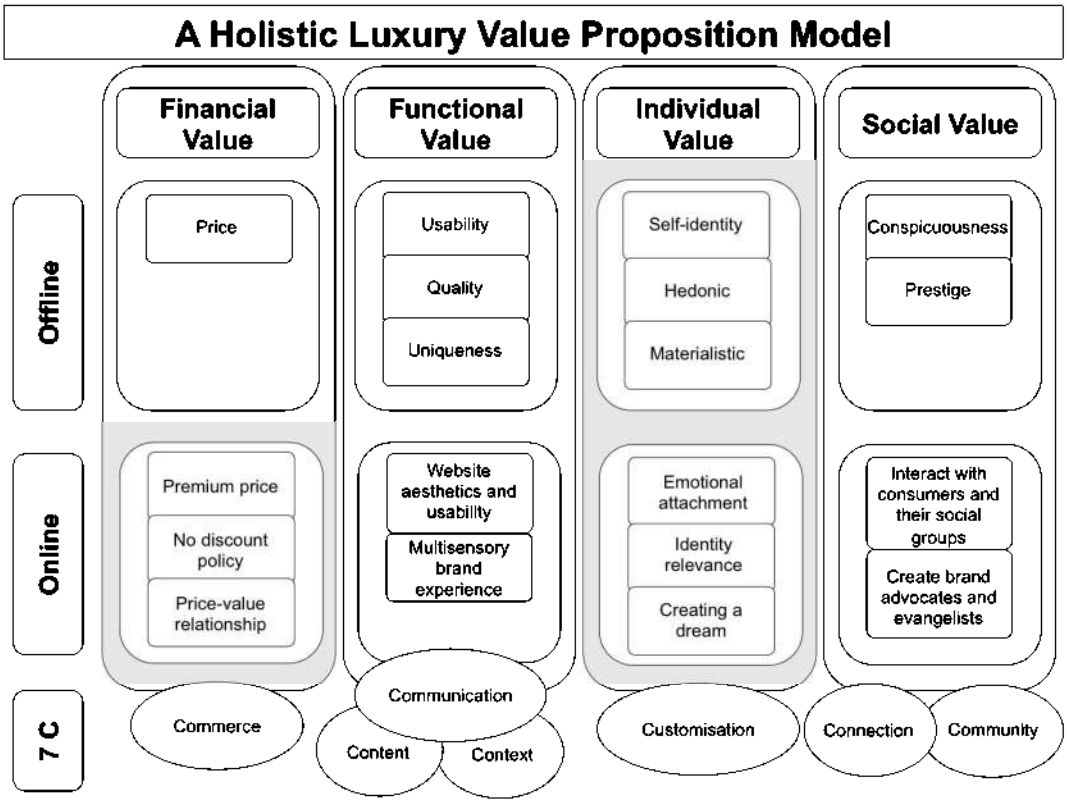


Figure 5: A Holistic Luxury Value Proposition Model (Source: The Authors)

to meet or exceed customer's expectations, to assure sophisticated social media presence and to participate in two-way communication on social media (Abrams Research, n.d.).
The e-business brought many challenges and opportunities for growth in luxury industry. Luxury brands should translate their brand message in the digital environment taking care not to diminish existing values and brand philosophy. However, in order to translate those opportunities into growth and success it is necessary to apply strategic and organised approach to online business in terms of holistic approach presented in the figure above.

4.1. Burberry Case Study

Burberry, the main representative of British fashion scene, was founded almost two centuries ago, in 1856 (Burberry, 2014). Burberry's strategy proved to be successful over the decades as Burberry always finds its place in the top of the lists of the world's best brands (Deloitte, 2014a). Moreover, according to Galloway (2013, p.5) Burberry is the most successful luxury brand when it comes to e-business. It started implementing its online strategy as of 2011 (Choi et al., 2014; Galloway, 2013). Moreover, when it comes to financial performance it is one of the most profitable luxury companies in European market (Choi et al., 2014; Deloitte, 2014). Given the fact that Burberry proved its quality and strong brand image over the years, its offline strategy will not be considered in this study. The focus of this study is to examine Burberry's online strategy and tactics in the light of the holistic concept presented in the Figure 5.

Burberry's vision to become the first company to be fully digitalised is supported by £30million investment that aims to connect Burberry with its customers, employees, partners and suppliers (Burberry, 2014; Choi et al., 2014). This investment also supports the value creation for new market through digital innovation, mainly through implementation of e-commerce. The value created in this way is supposed to provide the exactly same Burberry experience regardless of where, when and how customers are accessing the brand. Using this strategy, Burberry is not only targeting existing customers but also young people, potential customers,

who do not have money yet to invest in Burberry goods, however emotional connection that is built later can turn them into real consumers of Burberry luxury goods (Choi et al., 2014).
With the reference of Figure 5 presented in the previous section, tactics that Burberry applied in order to use opportunities of digital environment and consequently increase profits and strengthen the brand identity are presented in the Figure 6 below, in the "Online" section.

When it comes to Financial Value, Burberry keeps the same prices in online and offline stores, offering online discount only when in offline stores as well. Moreover, Burberry gives the benefit of international return policy whereby customers can return goods they are not satisfied with (Burberry, 2014; Choi et al., 2014; Rayport and Jaworski, 2001).

Functional Value in Burberry case offers profuse and high quality contents and benefits. Not only are Burberry goods presented in high-quality photos on their online platform but also in 360° view, which facilitates the experience of "see and feel" (Choi et al., 2014, p.6). Likewise, besides the real-time streaming of Burberry fashion shows (Runway to Reality), its customers can order looks straight from the catwalk as of 2012. Moreover, Burberry's customer support centre is available 24/7 in 14 different languages (Burberry,

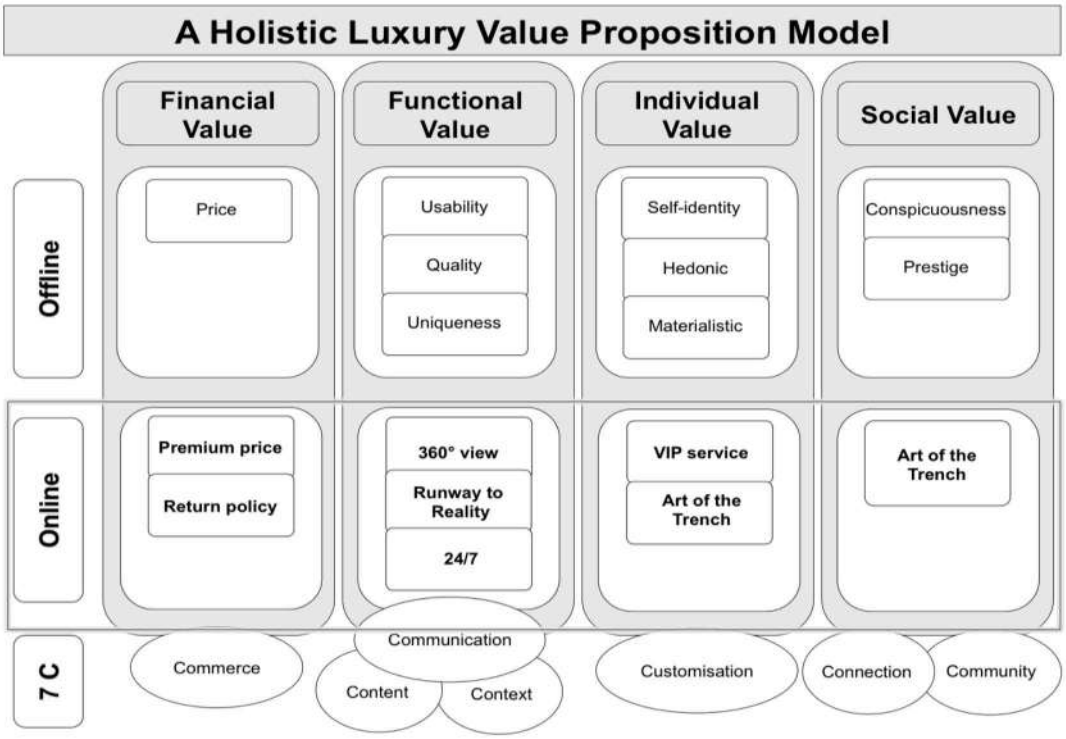


Figure 6: A Holistic Luxury Value Proposition Model- Burberry case (Source: The Authors)

2014; Choi et al., 2014, p.7; Rayport and Jaworski, 2001).

Burberry's strategy in case of Individual Value is to provide support to very important customers (VIP) in order to preserve exclusive treatment that customers expect and also their loyalty. Besides that, both Individual and Social Value are supported with the feature "Art of Trench". This feature is actually Burberry's very own social network designed to allow customers to upload a photo of themselves in the famous and iconic Burberry's trench coat. In this way, customers of luxury goods can satisfy their need of conspicuousness. During the first year of launching, the Art of Trench network reached more than 11 million views (Choi et al., 2014). Moreover, this project created the community of its customers promoting Burberry's brand in the same time (Burberry, 2014; Choi et al., 2014, p.7; Rayport and Jaworski, 2001).

Burberry is the luxury brand with the highest digital IQ. The benefits of being involved in digital environment, even for luxury brands, are reflected in Burberry's financial performance. In 2012, Burberry had both revenue and operating profit growth of 24%. In addition, it increased brand awareness among young population (Choi et al., 2014). It can be concluded that all tactics Burberry uses to provide financial, functional, individual and social values for its customers not only remained faithful to original brand philosophy and tradition but also improved Burberry's business as a whole.

5. CONCLUSION

This paper examined how luxury brands could benefit by digitalising their business. Luxury brands perceive the Internet as a threat to attenuate the brand value. However, we argue that the question is no more whether luxury brands should adopt online business but how they should do it. Thus, the challenge is to deliver the unique experiences for their luxury products to their customers as they do in offline store.

The luxury customers worldwide have accepted the internet as a resource, communication vehicle and e-commerce platform. As the customers continue to spend more time online, a strategic approach to e-business will prove critical. Luxury brands would be negligent not to do the same. Although the primary purpose of luxury businesses has not changed, the most effective and efficient ways for reaching it have. According to the latest studies, luxury brands should invest in their online presence and translate their original philosophy into digital environment that should be understood as the extension of the existing business and not a new concept. Consequently, the progress of a luxury brand's digital presence translates to measurable gains in terms of financial performance and the number of people who interact with that brand.

This research used the case of the British luxury brand, Burberry, to show how this company adopted e-commerce and which tactics it used in the light of a holistic value proposition model developed in this study. As a result of all efforts when it comes to digitalisation, Burberry has become the most successful brand among the luxury fashion companies. As this paper argued, Burberry suitably translated and adapted its offline values, exclusivity and philosophy into online platform, which resulted in financial growth and brand awareness increment.

To succeed online, luxury brands must convey their quintessence to the digital environment and leverage the unique capabilities of the digital space to reach customers in modern and stirring way. Customers will only identify with a luxury brand that ads value to their own personality. Luxury brands that have adopted this are experiencing benefits across the various aspects from customer communities, to the raise of brand ambassadors, to enlarged brand awareness, to online sales growth and to increased market share.

REFERENCES

(Tsun-Yin) Tung, T., (Catherine) Jai, T., & Davis Burns, L. (2014). Attributes of apparel tablet catalogs: value proposition comparisons. *Journal Of Fashion Marketing And Management: An International Journal*, *18*(3), 321-337. http://dx.doi.org/10.1108/jfmm-12-2012-0073

Abrams Research,. *Social Media Guide for Luxury Brands* (1st ed.). Retrieved from https://faculty.cit.cornell.edu/jl2545/4550/materials/arsmediaguideluxury.pdf

Bain & Company,. (2014). *Luxury Goods Worldwide Market Study Fall-Winter 2014* (1st ed.). Bain & Company. Retrieved from http://www.bain.com/bainweb/PDFs/Bain_Worldwide_Luxury_Goods_Report_2014.pdf

Boyden,. *Consumer & Retail Practice: Luxury Retail Trends in Emerging Markets* (1st ed.). Retrieved from https://www.boyden.com/mediafiles/attachments/8733.pdf

Brun, A., & Castelli, C. (2013). The nature of luxury: a consumer perspective. *Intl J Of Retail & Distrib Mgt*, *41*(11/12), 823-847. http://dx.doi.org/10.1108/ijrdm-01-2013-0006

Burberry,. (2014). *Burberry Annual Report 2014* (1st ed.). Retrieved from http://www.burberryplc.com/documents/annual_reports/annual-report-2014-15.pdf

Chaffey, D. (2009). *E-business and e-commerce management*. Harlow, England: FT Prentice Hall.

Choi, S., Chai, S., Nam, Y., Yang, S., & Protoppa, C. (2014). *Success Factors For Luxury E-Commerce: Burberry's Digital Innovation Process* (1st ed.). Retrieved from https://www.academia.edu/7676346/Success_Factors_for_Luxury_E-commerce_Burberry_s_Digital_Innovation_Process

de Azevedo Rosa, C. (2012). *Luxury Today-Key Factors for Success* (1st ed.). Retrieved from http://www.g-casa.com/conferences/berlin/papers/Rosa.pdf

Deloitte,. (2014). *Global Powers of luxury goods* (1st ed.). Retrieved from http://www2.deloitte.com/content/dam/Deloitte/it/Documents/about- deloitte/GP_Luxury_2014.pdf

Dubois, B., Czellar, S., & Laurent, G. (2005). Consumer Segments Based on Attitudes Toward Luxury: Empirical Evidence from Twenty Countries. *Marketing Letters*, *16*(2), 115-128. http://dx.doi.org/10.1007/s11002-005-2172-0

Euromonitor,. (2013). *Luxury Goods: Global Trends and Prospects* (1st ed.). Euromonitor. Retrieved from http://www.euromonitor.com/luxury-goods-global-trends-and-prospects/report

Forte, D. (2014). *4 Key Trends in Global Ecommerce Growth - Multichannel Merchant. Multichannel Merchant*. Retrieved 24 March 2016, from http://multichannelmerchant.com/must-reads/4-key-trends-in-global-ecommerce-growth-10112014/

Galloway, S. (2013). *Digital IQ Index: Fashion - Ranking The Brands* (1st ed.). Retrieved from http://www.rankingthebrands.com/PDF/Digital%20IQ%20Index%20Fashion%202013,%20L2%20Th i nkTank.pdf

Hennigs, N., Wiedmann, K., & Klarmann, C. (2012). Luxury Brands in the Digital Age-Exclusivity versus Ubiquity. *Mark Rev St. Gallen*, *29*(1), 30-35. http://dx.doi.org/10.1007/s11621-012-0108-7

Herzberg, F. (1959). *The motivation to work*. New York: Wiley.

Hoffmann, J., & Coste-Manièl€re, I. (2013). *Luxury strategy in action*. Houndmills, Basingstoke, Hampshire: Palgrave Macmillan.

Kotler, P., & Armstrong, G. (2006). *Principles of marketing*. Upper Saddle River, N.J.: Pearson Prentice Hall.

Kotler, P., & Keller, K. (2009). *Marketing management*. Upper Saddle River, NJ: Pearson Prentice Hall.

Lee, Y., & Benbasat, I. (2003). Interface design for mobile commerce. *Communications Of The ACM*, *46*(12), 48. http://dx.doi.org/10.1145/953460.953487

Mau, D. (2015). *Why Some Luxury Brands Still Don't Sell Online*. *Fashionista.com*. Retrieved 24 March 2016, from http://fashionista.com/2014/03/why-some-luxury-brands-still-dont-sell-online

McKinsey&Company,. (2013). *Digital Luxury Experience 2013* (1st ed.). Retrieved from http://www.mckinseyonmarketingandsales.com/sites/default/files/pdf/Digital_Luxury_Experience_20 1 3.pdf

McKinsey&Company,. (2013). *Digital Luxury Experience 2013* (1st ed.). Retrieved from http://www.mckinseyonmarketingandsales.com/sites/default/files/pdf/Digital_Luxury_Experience_20 1 3.pdf

McKinsey&Company,. (2015). *Digital inside: Get wired to deliver the ultimate luxury experience* (1st ed.). Retrieved from http://ttp://www.mckinsey.de/sites/mck_files/files/dle-2015-global-report.pdf

Okonkwo, U. (2010). *Luxury online*. London: Palgrave Macmillan.

Radisavljevic, T. *Stratigic Planning for Internationalisation of SMEs: A Case of Serbian Fashion Designers* (Master). Heriot-Watt University.

Rayport, J., & Jaworski, B. (2001). *E-commerce*. Boston: McGraw-Hill/Irwin MarketspaceU.

Schultz, P., & Zelezny, L. (1999). Values as predictors of environmental attitudes: Evidence for consistency across 14 countries. *Journal Of Environmental Psychology*, *19*(3), 255-265. http://dx.doi.org/10.1006/jevp.1999.0129

Seo, Y., & Buchanan-Oliver, M. (2015). Luxury branding: the industry, trends, and future conceptualisations. *Asia Pacific Journal Of Marketing And Logistics*, *27*(1), 82-98. http://dx.doi.org/10.1108/apjml-10-2014-0148

Sheth, J., Newman, B., & Gross, B. (1991). Why we buy what we buy: A theory of consumption values. *Journal Of Business Research*, *22*(2), 159-170. http://dx.doi.org/10.1016/0148-2963(91)90050-8

Wiedmann, K., Hennigs, N., & Siebels, A. (2009). Value-based segmentation of luxury consumption behavior. *Psychology And Marketing*, *26*(7), 625-651. http://dx.doi.org/10.1002/mar.20292

DIGITAL MARKETING AND SOCIAL MEDIA IN HIGHER EDUCATION

Jovana Vujin
Faculty of Organizational Sciences, Belgrade
e-mail: vujinj1991@gmail.com

Abstract: *This paper presents opportunities of implementation digital marketing and social media marketing in higher education. The world of digital media is changing and progressing, and the way people are using technologies is constantly evolving. The goal of this paper is to analyze the potential of implementation digital marketing in higher education in Serbia. The paper shows that technical habits of students in Serbia are eligible for implementation of digital marketing and higher education synergy. Also, the paper presents the global digital marketing trends in higher education. The second part of the paper gives an example and first steps for implementation of this synergy. The institutions of higher education in Serbia have chance to use digital marketing and social media and introduce higher education into next technical level.*

Keywords*: Digital Marketing, Social Media Marketing, Social Networks, Higher Education, Search Engine Marketing (SEM), Search Engine Optimization (SEO)*

1. INTRODUCTION

The digital media world is changing constantly. Beside the technology progress, the way of using internet is evolving and changing. These changes are transforming not just how people access to information, but how they communicate and interact. Also, the way people choose and buy products and services is changing. Ryan and Jones point out that "People are embracing digital technology to communicate in ways that would have been inconceivable just a few short years ago. Digital technologies are no longer the preserve of tech-savvy early adopters, and today ordinary people are integrating them seamlessly into their everyday lives" (p.8). According to Parker “The explosion of new digital technologies and practices is also revolutionizing teaching and learning and there is probably no academic discipline more affected by the emergence of Internet technology than the field of marketing” (p.173). Today’s students often referred to as the “digital generation,” use an impressive assortment of technological tools in a wide variety of ways.

In 2011, Constantinides and Zinck noted that “the importance of the internet as commercial platform is by now universally recognized and increasingly businesses adopt online marketing channels at the cost of traditional ones. The social media, being second generation (Web 2.0) internet applications, allow interaction, one-to-one communication, customer engagement, and user generated content” (p.1).

All of this made a space for digital marketing and social media in education. This is primarily an opportunity for institutions of higher education in Serbia.

This paper presents the preconditions, the advantages and disadvantages for implementation digital marketing in higher education in Serbia and why is it so important for higher level educational system to implement digital trends.

2. DIGITAL MARKETING IN HIGHER EDUCATION

Integration of technology into the marketing classroom is not a new phenomenon. Nuldén noted that by the late 1990s, technology had become a routine component of the classroom pedagogy and of education in general (p.363). However, the technology and its integration in the marketing classroom have changer past ten years. According to Grewal and Levy “The changes and advances in social, mobile, and online technologies have created a perfect storm, forcing firms to change how they communicate with their customers” (p.84).

Hensen, Shneiderman and Smith pointed that digital and social media have changed the nature of interactions between customers and companies, engendering radically new ways of interacting and, essentially, revolutionizing marketing. As such, an integration of digital and social media into business marketing strategies is necessary to promote increased engagement and interaction (Coulter & Roggeveen,

2012). Engagement is the name of the game in marketing practice (Rohm & Weiss, 2014), and the marketing professoriate needs to be ahead of this technological storm instead of behind it (Crittenden, V. & Crittenden, W., 2015).

2.2. Digital marketing trends in higher education

Continuous monitoring of trends is necessary in every activity, including education. When big universities started using Social Media in education, most students immediately accepted the idea and actively involved, which shows that this channel of communication is close and familiar to them. Based on this, the conclusion is that this synergy can only bring positive results.

According to Hanover Research institutions of higher education are focusing on branding and marketing far more than previous years. Many have hired marketing professionals from the corporate world and invested significant time and money to create strong institutional brands (p.5).

Based on digital marketing trends defined by Hanover Research, the aditional trends that higher education institutions must follow if they want to implement digital marketing, are:

- Responsive website design: Institutions are placing more emphasis on responsive web design to create intuitive and easy to navigate websites that can be viewed on multiple devices and platforms.
- Search Engine Optimization and Search Engine Marketing (SEO and SEM) - the importance of this trend is reflected in the fact that educational institutions rank first places in search engines (Google). Also, Google Search Engine is constantly changing, so that more and more top results are paid ads. This makes institutions of higher education to invest resources in SEM.
- Uses of web analytics – Institutions of higher education are relying on data-driven analytics to determine who, how, and where they are reaching their audiences. The use of analytics software is increasing as the higher education web ecosystem is becoming increasingly complex, and the amount of online material institutions is expanding (domains, sub domains, etc.). Better analysis of this data is a new area of concentration for institutions of higher education.
- Strategic Social Media Management – like in many business areas, Social Media Management have a major impact on education. Most institutions of higher education in Serbia have accounts on at least one Social Network.
- Mobile development - Because of the rise of mobile technology and connected devices, colleges and universities are making greater investments in having a mobile presence. This includes not only mobile versions of websites and other content, but also making of mobile applications and BYOD (Bring Your Own Device) access to mobile devices.
- Content Management System and Customer Relationship Management (CMS and CRM) – Alongside the use of web analytics and other methods of harnessing “big data” in higher education, institutions of higher education are relying more heavily on content management and customer relations systems. CRM systems are especially important tools for admissions professionals engaged in outreach to prospective students, and also to make communication better and more efficient.
- Blogging and vlogging - Institutions of higher education should have a blog and a vlog. This will help students to solve everyday problems and answer to their most frequent questions.
-

2.3. Technology preconditions for the implementation of digital marketing in higher education

For making use of digital marketing in higher education successful, it is necessary to examine if our target group (students, 17-28) have daily access to the Internet. According to data from website Consumer Barometer with Google, on the chart Figure 1, we can see that the number of people who have access to the Internet from year to year is constantly growing, so in 2015, 97% of respondents said that they have access to the Internet. Also, the number of people who access the Internet every day is increasing, so we can say that these two categories are going to equalize, with the prediction that in a few years all people who will have access to the Internet, access the Internet every day.

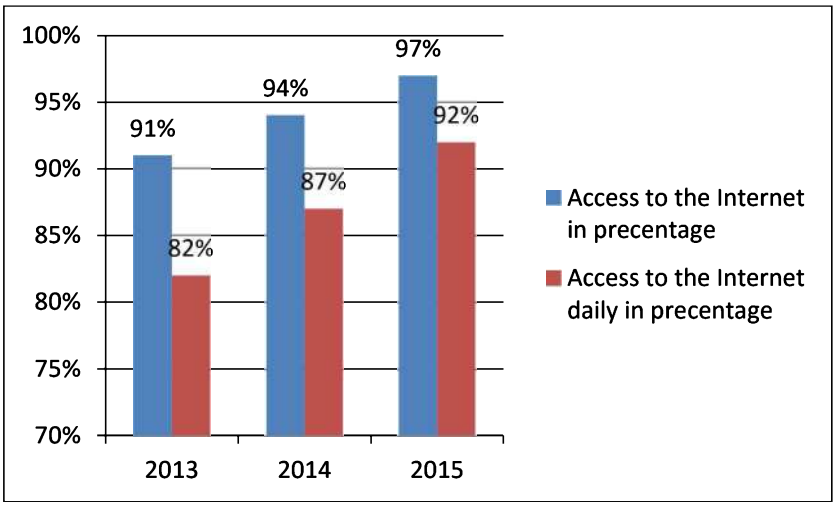


Figure 1: The ratio of people who have access to the Internet (%) and people who access the Internet daily
www.consumerbarometer.com

For implementation of digital marketing in higher education it is important that students can get information anywhere, anytime, and that the only requirement is the Internet access. This is enabled by the portable devices such as mobile phones and tablets. Of course, the use of computers is irreplaceable when we talk about writing papers, access online exams etc. On the chart, Figure 2 we can see the percentage of people (under 25) who use smartphones, computers and/or tablets. We can notice that the number of people who use computers since 2013. is in stagnation, while usage of smartphones recorded rapid growth.

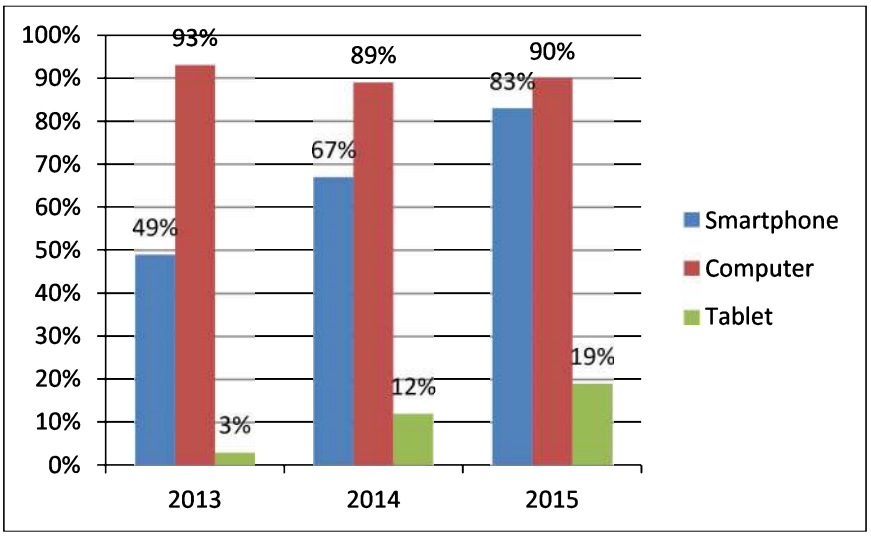


Figure 2: Percentage of people who use a smart phones, computers and tablets
www.consumerbarometer.com

Based on previous facts, we can conclude that Serbia fulfilled basic technology preconditions for the development of the synergy of digital marketing and higher education.

3. SOCIAL MEDIA IN HIGHER EDUCATION

The social media is a relatively new but fast-growing category of online interactive applications. These applications are based on user-generated content rather than supplier-generated allowing peer-to-peer communication and user-participation (Nambisan & Nambisan, 2008; Shankar & Malthouse, 2009).

Internet technology development in last years enabled that users can use Social Networks daily, in any place and at any time. Social Networks development caused that organizations and companies started to use them on the way that places them as an important part of marketing concept. That made some space for using Social Networks in educational purposes, which can be good chance for institutions of higher education.

Also, digital marketing and social network development changed the way that organizations/companies/institutions interact with users. With social networks, interaction became more simple and efficient.

One of the advantages of using social networks in higher education is that universities now can share different content, from sharing content directly from official website, to sharing various information which can be interesting for students, but can't be found on website. This is how institutions of higher education can come closer to their existing and potential students, because they show themselves as an institution which takes care of their students.

When we talk about students (existing and potential) as a target group (17-28 y/o), almost everybody from that target group owns smart phone or some other portable device. Social networks became important thing in student's life. They are something like personal information card, where you can find many details about user's life, from statuses where they write about their daily routine, photos and videos, to their relationship status and their likes. Social networks users are used to get important information in real time from those communication channels. The main indicator of good online interaction between institution of higher education and students are Facebook groups where information about exams, results of exams, important dates and other experiences are exchanged. Based on this indicator, we can conclude that there is definitely a place on social networks which is reserved for institutions of higher education.

The most used social networks in Serbia are Facebook (3,2 million users), Twitter (350.000 users), Instagram (360.000 users), LinkedIn, Google+ (as special groups which are created and used for special purposes) and YouTube (reach 47%, with TA music) (McCann Ericson, Wave5, 2010).

Based on this indicators, we can conclude that population in Serbia is following global social network trends.

According to research by website Top Universities from 2014. year, the most students are using social network Facebook, but also, other social networks should not be ignored,

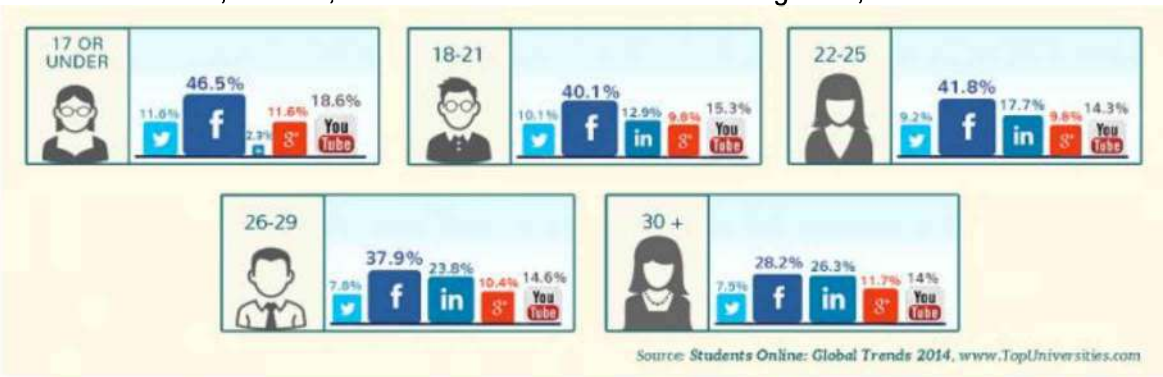


Figure 3: Students Online, Global Trends 2014
www.TopUniversities.com

As students mature, they are changing the way of using social networks. By the time, students are starting to use LinkedIn, because of their need for employment is increasing. (Tucker, L., 2014).

According to researches about the presence of the institutions of higher education on social networks, we can notice that the full potential is not used, and that there is a lot space for advance in presentation, engagement and interaction on social networks.

From the research conducted by the website emarketer.com from May 2015., (Table 1), we can see that the students (17-25 y/o) spend much of their free time online.

Table 1: Daily Time Spent on Social Networks (eMarketer, 2015)

Social Networks	Google+	LinkedIn	Twitter	Instagram	Facebook
0-1 hours	92.6%	89.5%	73.4%	57.6%	39.3%
2-3 hours	4.9%	7.8%	18.1%	24.1%	34.1%
4-5 hours	1.4%	0.6%	5.3%	10.3%	15.6%
6-7 hours	0.4%	1.2%	2.0%	3.9%	5.8%
8-9 hours	0.4%	0.6%	0.4%	2.5%	2.7%
10+ hours	0.4%	0.4%	1.0%	1.6%	2.5%

As we can see from the Table 1, the most respondents spend 0-1 hours daily on social networks, but also the number of people who are spending 2-5 hours is not low. Of course, there are extreme groups who spend online 6+ hours and if we consider only Facebook than this percentage is not negligible.

Because of the student's behavior the potential of the active presence of institutions of higher education on social networks is huge and definitely should be used. Institution of higher education should take advantage of social networks to encourage students by offering useful information.

3.1. Advantages and disadvantages of using social networks in education

As an educational tool, social media enriches the learning experience by allowing students and teachers to connect and interact in new, exciting ways (Lederer, K., 2012). There is an ongoing debate regarding the integration of social media in education. Guy point out "Advocates of social media usage point to the benefits of using social media for academic practice while critics are calling for regulations and/or the removal of such online technologies in the classroom. Finding middle ground has become a challenge" (p.12).

Advantages:

- Better open access to education
- Better integration and communication with students
- Better integration with students from distant locations
- Better integration between students and professors
- Real-time efficient and fast communication
- Enabling and presentation tools that help students in solving problems
- There are no age limits for the level of difficulty, students can learn at their own pace
- Reducing the cost of travel for students (in combination with an LMS system)
- Presentation of institution of higher education in the best possible way
- Presentation of study programs to high target group from any location
- Increase student motivation
- The participation of the masses. Scientific material may be accessible to the general mass
- A combination of formal and informal learning
- Availability on portable devices (smart phones, tablets)

Disadvantages:

- Social networks can disrupt student in learnigng.
- Cyberbulling - Open side of comunication have that disadvantage, i.e. proffesor can be disturbed by the students, or students can be disturbed beetwen themselves.
- Face-To-Face communication absence - We are still living in time in which is FTF comunication considered as the most relevant and efficient. This can be changed by the change of generations.
- Students maybe still don't get the seriousness of this way of learning, because they are still thinking of social networks as a way of fun

4. AN EXAMPLE OF IMPLEMENTATION OF DIGITAL MARKETING AND SOCIAL NETWORKS IN HIGHER EDUCATION

The Institution of Higher Education in Serbia wants to implement digital marketing and social media marketing in the education system. It is necessary to have a website with generated content which will be the final destination of using any digital marketing tools.

Website of The Institution of Higher Education can provide a basis for an engaging user environment (Weiss, 2008) and the social media is an ideal extension for the relational marketing activities due to their collaborative and interactive nature (Zinck Stagno, M., 2011). Website must follow the technology trends, be innovative and to give students all needed information. Having a mobile-responsive website is also important with the growth of smart phone and tablet use, particularly amongst young adults which are our target group.

Looking at the experiences from the business practices (Constantinides, 2010), one could argue that such strategies can provide higher university institutions with new communication possibilities allowing direct engagement with potential students. Such engagement can involve interaction with institutions of higher education recruiters or interactions with other students during the process of searching for a suitable study

and university. Engaging potential students in the social media domain is in principle an inexpensive way for universities to attract and persuade potential students. Social networks or online communities created by schools as part of their online presence can bring together potential student with students who already enrolled, or with peers looking for similar information and help (Zinck Stagno, M., 2011).

First, The Institution of Higher Education must work on SEO optimization and invest in SEM campaigns. Students are using search engines as their first source of information for higher education institutions and 9 of 10 are not knowing which institutions of higher education they wish to attend during initial research stages,. It's more important than ever to make sure that the website of The Institution of Higher Education looks and operates to a high standard to show up within the top search results. Unlike other industries, users who are looking for higher education information don't just stop at the homepage, but navigate through sites to find admission and course information, student associations and even details on what student life is like on faculty. This is why an SEO optimization is very important and could bring only benefits to the institution of higher education. Also, when potential student Google institution of higher education, on Google Search will first appear paid results. Because of that, The Institution of Higher Education has to invest resources for SEM campaign.

With the right strategy, Social Media can make studying more collaborative and efficient, and bring benefits to the both side, The Institution of Higher Education and students. The Institution of Higher Education should open accounts on the most popular Social Networks in Serbia, and those are Facebook, Twitter, YouTube, LinkedIn, Instagram and Google+ (just for special needs). Social Media Networks are an ideal way for institution of higher education in Serbia to engage with students. Social Media enables talking with students in real time, answering their questions and directing them to the website. This will not only increase the traffic to the website, but it will also enhance the user experience, allowing students to view institution of higher education as helpful and student-focused. Social Media also gives the opportunity to connect with other educational associations. Also, The institution of higher education can share important and interesting information, student's life quotes, courses, exam results, etc. This all will help students, but it also can help The institution of higher education in future development and growth.

Those are the first steps for implementation of digital marketing, and when this sets properly, next steps are following and implementation of digital marketing global trends.

5. CONCLUSION

There are many advantages that can bring synergy of digital marketing and higher education, like better open access to education, more efficient and real-time communication and interaction, making students more satisfied, branding and attracting new students, etc. The institutions of higher education in Serbia have fulfilled basic technology preconditions for the development of the implementation of digital marketing and higher education. Also, because of student's behavior the potential of the active presence of institutions of higher education on social networks and implementation of digital marketing is huge and definitely should be used.

REFERENCES

Constantinides, E. & Zinck S.M. (2012). Higher Education Marketing: A Study on the Impact of Social Media on Study Selection and University Choice. International journal of technology and education marketing, 2 (1). 41 - 58. ISSN 2155-5605

Constantinides, E. (2010). Connecting small and medium enterprises to the new consumer: The Web 2.0 as marketing tool. In: P. Bharati & I. Lee (Eds.), Global perspectives on small and medium enterprises and strategic information systems: International approaches. IGI Global, Hershey, PA, USA, 1-21. ISBN 9781615206278

Coulter, K. S., & Roggeveen, A. (2012). "Like it or not": Consumer responses to word-of-mouth communication in on-line social networks. Management Research Review, 35, 878-899.

Critternden, V., & Crittenden, W., (2015). Digital and Social Media Marketing in Business Education: Implications for Student Engagement, Journal of Marketing Education, DOI: 10.1177/0273475315588112

Emarketer. (2015). College Students Still Spend Most Social Time with Facebook. Retrived from http://www.emarketer.com/Article/College-Students-Still-Spend-Most-Social-Time-with-Facebook/1012955

Grewal, D., & Levy, M. (2016). Marketing (5th ed.). Irwin/McGraw-Hill

Guy, R. (2012). The use of social media for academic practice: A review of literature. Kentucky Journal of Higher Education Policy and Practice, Volume 1, Issue 2 , Article 7.

Hanover Research. (2014). Trends in Higher Education Marketing, Recruitment, and Technology. Retrieved from http://www.hanoverresearch.com/media/Trends-in-Higher-Education-Marketing-Recruitment-and-Technology-2.pdf

Hansen, D., Shneiderman, B., & Smith, M. A. (2011). Analyzing social media networks with NodeXL: Insights from a connected world. Boston, MA: Elsevier

Nambisan, S., & Nambisan, P. (2008). How to Profit From a Better Virtual Customer Environment. MIT Sloan management review, 49(3), 53.

Nulden, U. (2001). E-ducation: Research and Practice. Journal of Computer Assisted Learning, 17: 363–375. doi: 10.1046/j.0266-4909.2001.00193.x.

Parker, B.J. (2014). Innovating the Marketing Curriculum: Establishing an Academic Major In Internet Marketing, Atlantic Marketing Journal: Vol. 3: Iss. 2, Article 13.

Rohm, A., & Weiss, M. (2014). Herding cats: A strategic approach to social media marketing. New York, NY: Business Expert Press.

Ryan, D., & Jones, C. (2009). Understanding digital marketing: Marketing strategies fon engaging the digital generation (2nd ed.). United States: Kogan Page Limited.

Shankar, V., & Malthouse, E. C. (2009). A Peek Into the Future of Interactive Marketing. Journal of Interactive Marketing, 23(1), 1-3.

Tucker, L. (2014). Using Social Media Marketing in Higher Education, Retrieved from http://www.topuniversities.com/blog/using-social-media-marketing-higher-education

Wave5. (2010). The Socialization of Brands, Retrived from http://www.slideshare.net/MRMbelgrade/wave-5-srbija-i-svet?next_slideshow=1

ANALYSIS AND VALIDATION OF SUCCESS FACTORS OF MOBILE APPLICATIONS AS E-MARKETING TACTIC

Natasa Đurđević
Faculty of Organizational Sciences
e-mail: ndjurdjevic@coca-cola.com

Abstract: *With fast penetration and adoption of smart phones, mobile marketing and mobile applications as one of the possible mobile marketing tactics are increasingly gaining relevance. Previous theory and research dealing with mobile applications and mobile marketing typically covered one (or few) aspects: technology, process or user experience, defining success factors and good practices. Using the example of Tastly application in Serbia, this paper attempts to integrate all of the mentioned aspects and validate success factors. Main theoretical guidelines have been validated with additional useful implications for marketing practitioners.*

Keywords*: mobile marketing, mobile application, native type, agile methodology, user experience*

1. INTRODUCTION

Mobile communications accelerate with fast adoption of smart phones and that also drives significant growth of mobile applications market. Mobile phone's ubiquitous nature and the fact that the user almost never separates from it make this device an attractive channel for direct, two-way, real time communication with the consumer. Most of the scientific papers so far covered one (or few) functionality and success aspects and factors of mobile apps. Using the example of Tastly application in Serbia this paper analyses complete approach for development, launch and maintenance of a mobile app as a marketing communication tactic, covering the aspects of process, technology and content. The objective is to validate theoretical assumptions of successful use of mobile application as a tool for consumer communication.

2. SMART PHONE AND MOBILE APPLICATIONS RELATED TRENDS AND IMPLEMENTATION IN MARKETING

Fast adoption of smart phones drives dramatic growth of mobile applications market. This segment is one of the fastest growing industries (Datta, Kajanan, 2014). IDC forecasted 182.7 billion mobile apps downloads in 2015 (Păvăloaia, 2013). With more than 2.6 billion smart phone users in the world, mobile communications industry alone contributed to 4.2% GDP growth globally last year, with mobile apps and services segment ranking second in size (GSMA, 2016). Internet via mobile phone accounts for 25% of total internet traffic in 2014 (Yan et al., 2014). Forrester forecasted that 42% of world population would own a smart phone in 2015 (Forrester, 2014), while GSMA recorded 60% smart phone penetration in Europe (GSMA, 2016).

With no physical location limitations, mobile technologies allow advertisers and retailers to contact their consumers always and everywhere (Fong et al., 2015). Possibility of contact anytime and anywhere are significant advantages of mobile devices (Persaud, 2012). Even though 90% of purchases are still made in brick-and-mortar stores, 70% of consumers use a mobile phone prior to purchase, more than 50% of purchase decisions are influenced by mobile phone and this technology increases conversion by about 40% (RetailmenotInc, 2015). Smart devices allow marketers to develop a wider range of pull-based services and employ a larger set of marketing techniques (Persaud, 2012). In 2015 in USA more than half of total digital communications investments have been allocated to mobile devices (eMarketer, 2015).

Association for Mobile Marketing defines it as set of practices that enable organizations to communicate and engage with their target audience in an interactive and relevant manner and with any mobile device or network (MMA; Ström et al., 2013). Mobility can be related to mobile medium, device, channel or technology (Shankar et al., 2010). Some of mobile marketing tactics are SMS, MMS, mobile banner, QR codes, mobile applications, mobile web design (Hadadi and Almsafir, 2014) etc. Presence of various sensors and services within a smart phone enable geo-targeting, motion triggers, beacon activations and so on.

3. SUCCESS FACTORS OF USING MOBILE DEVICES AND APPLICATIONS IN MARKETING

Mobile phone is almost always on its user which allows for communication everywhere and always and implementation in marketing (Persaud, 2012; Bauer et al., 2005; Banerjee and Yancey, 2010). One of important questions covered in numerous scientific papers was the question of utility and value. Perceived utility impacts acceptance and use of mobile technology and acceptance of marketing services (Ström et al., 2013). Bauer (Bauer et al., 2005) finds that entertainment and information value are most important factors of perceived utility. Value or benefits can be defined as utilitarian, emotional, social and monetary (Ström et al., 2013). Issues in mobile marketing are the result of variety of platforms, data security and privacy, obtaining permission for communication, ease of navigation, user experience, battery power, processing and memory power of the device etc. (Hadadi and Almsafir, 2014; Watson et al., 2013; Mahmud et al., 2014; Rupnik, 2009).

3.1. Mobile applications for smart phones

Mobile applications on smart phones are a specific tool for target group communication and activation. Mobile application is a software that operates on mobile devices using the operating system of the device (iOS, Android…) (Datta, Kajanan, 2014), i.e. it is a program that runs on mobile devices and presenting value to the mobile user (Rupnik, 2009).

"Mobile first" approach in today's practice (TCCC, 2015) helps avoid poor user experience resulting from browsing web pages which are not tailored for mobile devices (Guirguis, Hassan, 2010). Older web applications face challenges from variety of browsers and their compatibility, screen size and resolution, security, operating systems, touch-screen interface, usage of camera, location service, screen rotation and other device features.

3.2. Technology aspects of mobile applications

Mobile application development is a set of processes of writing software for small and wireless computing devices (Mahmud et al., 2014). Technical aspects include application type, operating system, web service and architecture.

There are three types of applications: web, hybrid and native. Figure 1 provides comparison of different application types (Mahmud et al., 2014):

Criteria	Type of mobile application		
	Web	Hybrid	Native
Development cost	Reasonable	Reasonable	High
Speed	Fast	Native speed	Very fast
Device access	Partial	Full	Full
Approval process	None	Low overhead	Mandatory
Application store	Not available	Available	Available
Multi cross platform support	Full support	Full support	Limited support
Native look and feel	Limited support	Some support	Full support
Access to peripheral SDK	Limited support	Some support	Full support

Figure 1: Differences between web, hybrid and native applications

Hybrid type is recommended to optimize budget, development and maintenance of application, while native application offers best user experience and fully leverages device features and possibilities.

Application architecture defines user-server architecture and usually has multi-layered structure: user, presentation, services, cloud service, data (Păvăloaia, 2013; TCCC, 2015). This defines, for example, how application can operate without server connection, storing data on local database until server connection is restored and data transferred (Mahmud et al., 2014).

3.3. Mobile application development process

General software development cycle assumes four phases: analysis, design, implementation and testing (Rahimian and Ramsin, 2008) and this can also be applied for mobile applications development. Somewhat

detailed process according to (Maharmeh and Unhelkar, 2009) includes: project initiation, project plan, analysis, design, coding, testing, deployment, post implementation (closure).

There are many process types that can be applied for applications development (Waterfall, iterative, V model, spiral, prototype model, agile) (Păvăloaia, 2013; Maharmeh and Unhelkar, 2009), and each has certain advantages regarding level of detail in planning, risk reduction or user collaboration during development.

Agile methodology has been accepted as the best practice for mobile applications development – design and implementation are key activities of development process (Păvăloaia, 2013; Mahmud et al., 2014; Rahimian and Ramsin, 2008). This process is incremental, cooperative, simple and adaptable (Abrahamsson, 2002).

3.4. Mobile application content and user experience

Marketers see mobile marketing as a vehicle for direct, personalized contact with consumers without temporal or spatial barriers, while perceived utility and relevance are among most important factors of mobile applications acceptance and usage by the end user (Watson et al., 2013). Assuming basic requirements of data security and privacy are fulfilled, users are ready to exchange their personal data for useful services (Persaud, 2012; Ström et al., 2013). According to Xu (Xu et al. 2014) convenience and simplicity are main reasons for using mobile services. Personal data can be obtained actively (provided by user) or passively (generated by technology) (Pousttchi and Hufenbach, 2013; Xu et al. 2014), and they are the basis for building and applying CRM (Hadadi and Almsafir, 2014; Xu et al. 2014).

Smart phones and tablets are mainly used for social networking, content sharing and personal productivity (Bancora et al., 2015). Therefore, integrating applications with device functionalities (camera, geo-positioning, calendar, planner…) helps fulfil these needs (Hadadi and Almsafir, 2014).

Keeping same approach in digital communication development for web and mobile phones is inefficient and provides poor experience for the user (Guirguis, Hassan, 2010). “Mobile first” approach becomes a standard that marketers are adopting more and more, but certain potential problems still remain: different screen sizes, content optimization to screen, ease of navigation, connection quality, battery life, memory capacity, processor speed, security (eMarketer, 2015; Rupnik, 2009).

Users recognize added value for tailored content, adapted to context, individual preferences, location, time, activity and interactivity (Fong et al., 2015; Persaud, 2012; Ström et al., 2013; Unhelkar and Murugesan, 2010).

4. TASTLY MOBILE APPLICATION EXAMPLE

As part of the small baskets project, The Coca-Cola Company identified the opportunity to use mobile devices for customer communication during pre-shop phase.

Based on extensive shopper behaviour research (Company’s standard global methodology) in a few markets of Central and South Europe (CSE), one of key behavioural models of shoppers when on small basket missions is the “mental shopping list” (shopper knows what is needed to be purchased on this routine shopping mission, but does not have that list written down) – preparing for this shopping trip the shopper (in this case a mum) thinks about what to prepare for the main meal of the day, which food items she may still have at home, where would be most convenient to do the shopping, how much money she has available… In addition to checking household stocks, internet becomes important source of information and inspiration when preparing for the shopping trip i.e. preparing the main family meal.

One of key marketing activation platforms for brand Coca-Cola is “Coke & Meals”. Main activation tactics until 2015 were focused on traditional media and retail outlets, with limited use of digital media and social networks. Data from different markets indicated that a lot of mums (main target group for this platform) currently and increasingly more use internet and especially mobile phone during shopping preparation – searching for information, recipes for inspiration, recommendations, checking prices and looking for offers. Central shopper marketing team for Coca-Cola in CSE identified the opportunity to implement mobile marketing as tactic that could respond to shoppers’ needs.

4.1. Application development process validation

Application development process will be validated according to Maharmeh (Maharmeh and Unhelkar, 2009): project initiation, plan, analysis, design, coding, testing, deployment and post implementation.

Based on insights from above mentioned shopper studies, shopper team briefed the agency to propose relevant solutions for defined target group activation objectives. Agency proposal included development of a mobile application which would contain following features: recipes for inspiration, shopping list creation, current promotions and leaflets across retailers, retail outlets maps and various entertainment content (music, fashion).

Idea was interesting and decision to initiate the project was made. Key objective of this phase was success and sustainability assessment of such an initiative. With people, financial and technical resources limitations, project team was tasked to develop a sustainable plan.

First step was the extensive analysis of existing market offering. Application development is not the core competency of The Coca-Cola Company – challenge was to develop something new that would be differentiated and useful to users. Reviewing more than 30000 existing application related to cooking and shopping, following key functionalities were identified: step-by-step recipes, useful tips, local cuisine relevance, shopping list creation, sharing. None of the existing apps provided all of them.

Next stage was defining way of working – internal vs external development and maintenance team, inclusion into existing Company IT systems or using market available IT solutions, development model options, possibility to maintain and keep relevance across all CSE markets and beyond (globally), reviewing locally relevant resources needed to maintain local app version, ways of sourcing content for the app (relevance and reliability or sources, legal requirements and limitations, intellectual property solutions, sufficient content quantity) and estimation of financial resources needed for launch, expansion and maintenance.

Satisfactory solutions from the analysis stage were given the approval for project launch, i.e. approval of the plan with all technical, organizational, financial and timing details. Serbian market was selected as pilot market for this project.

Application design was initiated – architecture, graphic design, coding. Beta versions were tested on limited number of users, mainly Coca-Cola system and partner agencies employees. Beta testing took five months, until final version was ready for full launch.

Prior to launch, success criteria were defined – those would be used to validate the pilot and decide on expansion in Serbia and other countries. Main KBIs were: 25% user base of target group of mums smartphone users (69000) within 4 months, daily users (5000), application rating (>4).

In September 2015 Tastly application became available on Google Play and App Store for Android and iOS smart phones. The app is free for the user, in accordance with validated practice of launching apps free of charge as an effective way to build awareness, affinity, creating usage habits and word of mouth expansion (Datta, Kajanan, 2014; Liu et al., 2012; Kim and Morris, 2007). Distribution and discovery are very important phases of the process, as per internal Company process – in addition to app stores availability, launch media plan for advertising in digital media was put together, containing banners with link to app store as well as PR texts on target audience and topic relevant sites and pages (recipes, cooking, family, shopping etc.). Results have shown significantly higher efficiency of PR texts (Figure 2 and Figure 3).

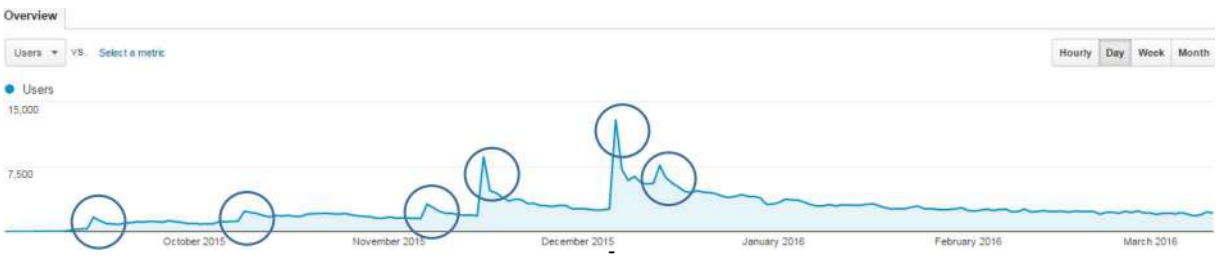


Figure 2: Daily overview of new users for Android version of Tastly app for Sep 2015 – Mar 2016

Figure 3: Daily overview of new users for iOS version of Tastly app for Sep 2015 – Mar 2016

Number of users surpassed the set target (reaching more than 85000), as well as the application rating (4.6), while daily users were below set target (reached 2500) (Figure 4 and Figure 5). Since the number of regular users is extremely high (89% for Android and 81% for iOS version), as well as the number on weekly users, pilot was evaluated as positive.

Figure 4: Activity overview for Android version of Tastly app Sep 2015 – Mar 2016

Figure 5: Activity overview for iOS version of Tastly app Sep 2015 – Mar 2016

Tastly app will continue to be used as a marketing tactic in Serbian market and will be further developed and it will be launched in other markets of CSE. Based on experience in Serbia, team has defined precise process with mandatory steps and guidelines for other markets how to proceed in preparation, launch and activation. In line with brand objectives and consumer behaviour and needs analytics new functionalities will be added, and that is another factor of success for an application according to Datta (Datta, Kajanan, 2014).

Whole process can be illustrated as in Figure 6, showing which functions were involved, in which way, at each of the project phases. For clarification, following is the meaning of abbreviations: CIC – Consumer Interaction Centre (locally responsible person for consumer interaction in digital media), CCH – Coca-Cola Hellenic, local bottler.

Function / Project phase	Shopper Marketing	CIC	IT	Digital	Marketing	CCH	Developer	Media Agency
Project initiation	R/A	C		C	C			
Plan	R/A	R/A	C	C	C	I	C	
Analysis	R	A		C	I		A	C
Design	R	A	C	C	A	C	A	
Coding	R	C	C	C			A	
Testing	R	A	C	I	A	I	A	I
Deployment	C	R	C	I	A	C	A	A
Post implementation	R/A	A	C	I	A	C	C	I

RACI: Responsible, Accountable, Consulted, Informed

Figure 6: Internal process of Tastly application development

To conclude, more detailed process as per (Datta, Kajanan, 2014) in this case was more useful than the simpler general version as per (Rahimian and Ramsin, 2008) for the following reasons: it allows for more detailed steps during preparation and planning, it provides for steps after testing and deployment and it assumes testing prior to deployment which prevents launch of suboptimal application version.

4.2. Application development model validation

As mentioned in 3.3 agile application development methodology has been accepted as best practice (Păvăloaia, 2013; Mahmud et al., 2014; Rahimian and Ramsin, 2008). The process is incremental, cooperative, simple and adaptable (Datta, Kajanan, 2014; Abrahamsson et al., 2002), which was relevant in case of Tastly.

Team that worked on application preparation and launch was small and flexible, with following members: central shopper team, local digital team (Company and agency), central IT team, developers, local marketing team, local bottler representative, local media agency. Communication between team members was frequent and direct, on needs be basis, not only as per protocol. Each team members used his own network of friends to include users to test the app and collect feedback to improve functionalities.

Architecture is multi-layered, as per best practice defined by (Păvăloaia, 2013; TCCC, 2015). It is cloud hosted, which helps overcome device limitations of processing power and memory capacity, and it allows for contextual user engagement and geo-targeting (Gupta and Agarwal, 2015). User data are also stored in cloud, currently using external analytics and CRM services, while user engagement tactics are being evaluated and tested for scalability.

This approach enabled entire development and beta testing to be completed within 8 months and pilot validated within a year since project initiation, keeping costs at acceptable level.

4.3. Application content validation

Tastly has been developed as native application for Android and iOS because quality user experience and connection with device functionalities have been defined as main objectives (Mahmud et al., 2014; TCCC, 2015).

Based on available consumer insights, application functionalities fit users' needs when preparing for shopping, meal planning, managing household budget, and simplifying shopping. Tastly has following features: recipes search and browsing, shopping list creation, current retailer leaflets and promotions review, store location relative to user's location, possibility to share comments, ask questions, share content, connecting with social networks profiles.

Knowing that privacy and data protection is very important to users (Jiang et al., 2015; Hadadi and Almsafir, 2014; Pousttchi and Hufenbach, 2013; Persaud 2012; Bauer et al., 2005), Tastly does not require identification or registration, but allows for optional link to Facebook and Google+ account. Passive data resulting from using the application enable anonymous application analytics (Xu et al., 2014): recipes search and browsing, shopping list content and geolocation will be used to develop algorithms for user engagement in the coming months, in collaboration with retailers (via notifications and beacons in stores).

This application is also an example of content creation solution, which is becoming frequent practice by advertisers (Jutkowitz, 2014). Tastly is an integral part of total marketing plan for "Coke & Meals" platform – source of recipes are mum food bloggers, it features current retail promotions, retail outlets are mapped and described, it links with social networks and relevant media.

There are multiple indications that right solutions regarding content have been implemented: high application rating, high percent of regular users, positive comments about the app and within the app, interactivity between users and their recommendations. It has all been based on understanding consumers' needs and creating solutions to their needs, coupled with visual graphic design and technical solutions. According to Datta (Datta, Kajanan, 2014), regular application updates and development of new features and content drive success, which would be validated in the coming months when new features will be added to Tastly.

Analysing in-app behaviour flow (Figure 7) indicates opportunity to improve visits and usage of shopping list. This feature is important to the Company for the purpose of measuring efficiency (during pilot period, presence of Coca-Cola brand in the shopping list (as the best approximation of purchase) has been three times higher than incidence in purchases measured by household panel).

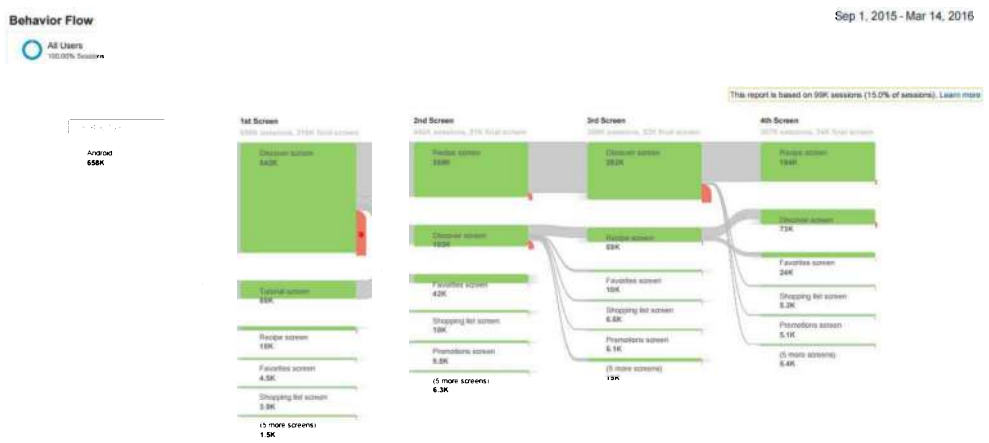


Figure 7: Overview of behavior flow for Android version of Tastly application for Sep 2015 – Mar 2016

Statistics show that it is very hard to succeed in mobile applications market: out of more than a million available apps, average user actively uses about 24 apps per month, spending more than 80% of time on only 5 (Forrester, 2014). During pilot, Tastly was among top five downloaded apps in Serbia, with excellent statistics on regular users.

For The Coca-Cola Company important utility test for Tastly will be when personalized communication and offers will be activated, as well as geo-targeting and beacons activation within retail outlets. All of these are validated success factors for mobile applications and mobile marketing in general (Fong et al., 2015; Gupta and Agarwal, 2015; RetailmenotInc., 2015; Xu et al., 2014; Banerjee and Yancey, 2010; Rupnik, 2009; Bauer et al., 2005), providing platform for collaboration with retailers and direct tracking of efficacy via sales results.

5. CONCLUSION

With fast penetration of smart mobile phones, use of mobile devices for consumer communication becomes increasingly important. Theory on processes and methodologies about mobile applications development is abundant, with established recommended best practices. There are also many academic papers that analyze success factors of mobile marketing and mobile applications. This paper attempts to validate good practices and success factors using the example of Tastly mobile application, developed by The Coca-Cola Company.

Selected exampled demonstrates high level of success a mobile application as a mobile marketing tactic can reach by respecting and deploying efficient processes, technologies and management. In this case, agile methodology and extensive process were significant for success – from clear objectives, flexible, small and dedicated team with frequent interactions, thorough testing, results tracking and tactics adjustment during implementation, to clear directions for future application evolution and management.

Regarding content, most critical for success was understanding potential users' needs and creating the application as response to those needs. Regular updates and information accuracy help maintain user satisfaction. Also, timely reactions to users' comments and questions, as well a regular tracking and analytics are important to succeed and require dedicated human resources.

Possible future research in terms of further understanding success factors can be in domain of dynamics and scope of improvements in new application releases and what is the most efficient way to inform existing and potential users about those changes, as they could be important to attract new users and drive frequency with existing occasional users. In addition, possibilities for partnering with retailers (and other partners) in real or digital world and measuring direct impact on brand perception, attributes and sales would be relevant to marketers to define the role and investment level into such tool as part of broader marketing plan.

REFERENCES

Abrahamsson, P., Salo, O., Ronkainen, J., & Warsta, J., (2002). Agile Software Development Methods: Review and Analysis, VTT Electronics

Bancora, M., Ripamonti, D., Vaccarella, A., Brambilla, M., (2015). Model-Driven Development and Business Process Modeling Applied to Personal Productivity in the Consumer Mobile App Market, 2015 2nd ACM International Conference on Mobile Software Engineering and Systems

Banerjee, S., Yancey, S., (2010). Enhancing mobile coupon redemption in fast food campaigns, Journal Of Research In Interactive Marketing, June 2010
Bauer, H.H., Barnes, S.J., Reichardt, T., Neumann, M.M., (2005). Driving Consumer Acceptance Of Mobile Marketing: A Theoretical Framework And Empirical Study, Journal of Electronic Commerce Research, VOL. 6, NO.3
Datta, D., Kajanan, S. (2014). Do App launch times impact their subsequent commercial success? An Analytical approach, 2013 International Conference on Cloud Computing and Big Data, 2014 IEEE
eMarketer, (2015). Mobile Advertising And Marketing Trends Roundup, December 2015
eMarketer, (2015). Retail Roundup, September 2015
Fong, N.M., Fang, Z., Luo, X. (2015). Geo-Conquesting: Competitive Locational Targeting of Mobile Promotions, Journal of Marketing Research Vol. LII, October 2015
Forrester (2014). Predictions 2015: Most Brands Will Underinvest In Mobile, November 2014
GSMA, (2016). The Mobile Economy 2016, https://gsmaintelligence.com/research/2016/02/the-mobile-economy-2016/541/
Guirguis, S.K., Hassan, M.A., (2010). A Smart Framework for Web Content and Resources Adaptation in Mobile Devices, The 12th International Conference on Advanced Communication Technology ICACT
Gupta, N., Agarwal, A., (2015). Context Aware Mobile Cloud Computing: Review, 2015 2nd International Conference on Computing for Sustainable Global Development (INDIACom)
Hadadi, K., Almsafir, M.K., (2014). The Relationship between Mobile Marketing and Customer Relationship Management (CRM), 3rd International Conference on Advanced Computer Science Applications and Technologies
Jiang, J., Shi, Z., Yuan, X., Wang, C., Gui, X., (2015). Towards Secure and Practical Targeted Mobile Advertising, Infocom 2015 Student Workshop (Poster Session), IEEE 2015
Jutkowitz, A., (2014). The Content Marketing Revolution, Harvard Business Review, July 2014
Kim, J., Morris, J. D., (2007). The power of affective response and cognitive structure in product-trial attitude formation, Journal of Advertising, vol. 36
Liu, C. Z., Au, Y. A., Choi, H. S., (2012). An Empirical Study of the Freemium Strategy for Mobile Apps: Evidence from the Google Play Market, International Conference on Information Systems, ICIS 2012
Maharmeh, M., Unhelkar, B., (2009). A Composite Software Framework Approach for Mobile Application Development, Handbook of Research in Mobile Business: Technical, Methodological, and Social Perspectives Second Edition, IGI Global
Mahmud, D.M., Abdullah, N.A.S., (2014). Mobile Application Development Feasibility Studies, IEEE Conference on Open Systems (ICOS), October 2014
MMA, http://mmaglobal.com/news/mma-updates-definition-mobile-marketing
Păvăloaia, VD. (2013). Methodology Approaches Regarding Classic versus Mobile Enterprise Application Development, Informatica Economică vol. 17, no. 2/2013
Persaud A., (2012). Innovative mobile marketing via smartphones: Are consumers ready?, Marketing Intelligence &Amp Planning, June 2012
Pousttchi, K., Hufenbach, Y., Enabling evidence-based retail marketing with the use of payment data - the Mobile Payment Reference Model 2.0, International Journal of Business Intelligence and Data Mining, August 2013
Rahimian, V., Ramsin, R., (2008). Designing an Agile Methodology for Mobile Software Development: A Hybrid Method Engineering Approach, Second International Conference on Research Challenges in Information Science. RCIS 2008, Marrakech
RetailmenotInc. (2015). 5 Strategies to Bridge the Mobile-to-Store Gap, mCommerce Daily, July 2015
Rupnik, R., (2009). Mobile Applications Development Methodology, Handbook of Research in Mobile Business: Technical, Methodological, and Social Perspectives Second Edition, IGI Global
Shankar V., Venkatesh, A., Hofacker, C., Naik, P., (2010). Mobile Marketing In The Retailing Environment: Current Insights And Future Research Avenues, The Journal of Interactive Marketing, February 2010
Ström, R., Vendel, M., Bredican, J., (2013). Mobile marketing: A literature review on its value for consumers and retailers, Journal of Retailing and Consumer Services, December 2013
TCCC, (2015). The Coca-Cola Company Enterprise Approach To Build Mobile Applications 1.0
Unhelkar, B., Murugesan, S., (2010). The Enterprise Mobile Applications Development Framework, IEEE Mobile Computing
Varnali, K., Toker, A.E., (2010). Mobile marketing research: The-state-of-the-art, International Journal Of Information Management, April 2010
Watson, C., McCarthy, J., Rowley, J., (2013). Consumer attitudes towards mobile marketing in the smart phone era, International Journal of Information Management 33
Xu, L., Jiang, C., Wang, J., Yuan, J., Ren, Y., (2014). Information Security in Big Data: Privacy and Data Mining, IEEE Access, The Journal for Rapid Open Access Publishing, October 2014
Yan, L., Ke, Y., Xiaofei, W., (2014). Association Analysis Based On Mobile Traffic Flow For Correlation Mining Of Mobile Apps, Proceeding of IC-NIDC2014

E-SERVICES IN THE REGULATION OF MEDICINES AND MEDICAL DEVICES

Tatjana Stojadinovic*[1], Igor Vanevski[1], Ljiljana Radovanovic[1]
[1]Medicines and Medical Devices Agency of Serbia
* Corresponding author, e-mail: tatjana.stojadinovic@alims.gov.rs

Abstract: *This paper presents the development of e-services and e-submission request of clients in the pharmaceutical industry as a subsystem of e-government of the Republic of Serbia. The main goal of this paper is to introduces the relationship of e-business in the regulation of medicines with other segments of e-government, e-health and e-pharmacy. The methodology for the development of e-services, methods for modeling and analysis of business processes, the reference model of e-business in the regulation of medicines are the main scientific contributions of this work. E-services development in the regulation of medicines, as one subsystem of the e-government implemented in Medicines and Medical Devices of Agency of Serbia, is a major professional contribution of this work.*

Keywords*: internet, e-government, medicines, e-services, e-submission*

1. INTRODUCTION

Electronic business (E-business) is the exchange of standardized electronic messages between natural and legal persons in negotiating, contracting, purchasing, sales, payments, communication with the administration and the courts, and in all other business transactions for which the law allowed its application (Ivkovic, Radenkovic, 1998).
E-business can be defined as "buying and selling of information, products and services through computer networks and support for any type of business transactions via the digital infrastructure." On the other hand, e-business can be seen as a process of conversion of digital inputs and outputs through a set of intermediaries. E-business is based on more modern work organization adapted to the use of ICT, internet usage in the performance of most business transactions, organization and implementation of information systems (IS), implementation of electronic signature and using cryptographic protection mechanisms. In the context of business operations relationships are established between companies and enterprises, enterprises and customers, buyers and customers and the rest, so that we can distinguish between the following business models: B2B (Business to Bussiness), B2C (Business to Customer), C2C (Customer to Customer)…
E-Government uses the application of information technology to improve: efficiency, productivity, transparency and accountability of the Government in dealing with: citizens, businesses and institutions, other government units and private officials. E-government can be seen from the "online access to services" to "tools for the construction and reconstruction of democracy"(Pedro, Gonnet, 2001). The objectives of e-government are: providing better services to citizens and businesses, clearer rules and procedures and less opportunity for corruption, and better control of costs and claims. In recent years, e-business and e-government there has been progress thanks to, on one hand, technological advances in the field of hardware, and on the other hand, the emergence of new methodologies in e-business and e-government. E-government is a Web-based technology that uses the local government as a communication channel, which is offered to visitors, citizens, business partners, other local governments and employees. Business models, which are used in the development of e-government are G2C (Government to Customer), G2B (Government to Business), G2G (Government to Government)...

2. E-BUSINESS IN THE REGULATION OF MEDICINES AND MEDICAL DEVICES

E-business has changed the traditional way of doing business. For regulation of medicines and medical devices, e-business is used for collecting, recording, storing and securing data, and information about medicines is a source of necessary information for the daily work of doctors, pharmacists and other health workers. The development of e-business in regulation of medicines, as one segment of e-government of Serbia provides interactive e-services tailored to the needs of citizens, public authorities, regulatory and educational institutions and industry (producers, representations, importers, representations of medicines and medical devices, health care and pharmaceutical institutions). The goal of this approach is the integration of e-government and the segment relating to the regulation of medicines, ensuring the efficiency of how the process of modeling and model implementation, which should result in models that must be

explicit, understandable, modular and can be effectively amended and supplemented, distrubuted and placed on a variety of computing platforms and operating systems in e-government.
E-business in regulation of medicines is one of the segments of the development of e-government in Serbia. Without e-business in regulation of medicines it is unthinkable to develop e-health and e-pharmacy. Providing information on medicines is one of the e-services in the regulation of medicines. Information about medicines is coming from routine sources, specific non-routine, library sources and research sources. Information on medicines, which must be precise and authoritative data are necessary for the daily work of doctors, pharmacists and other health workers in general and special branches of medicine, pharmacists in the production, medicines and pharmacies, as well as other professionals involved in health care, regulatory bodies. At this level, the information collected is detailed, often imprecise and poorly structured, while face to face contact provides sufficient information for the collection and processing. This information is then filtered, grouped and standardized. In a further move of information, less detailed information is required , but the number of people is getting bigger. Because of this, there is a need for standardization of terms and reports of how data can be easily grouped, analyzed and compared, and with a limit on the collection and analysis of just what is really needed.
Integration of eBusiness in the regulation of medicines and medical devices, eGovernment, eHealth and ePharmacy in Serbia (Figure 1) uses e-business models to better communication, better management of documents and records in public administration, the pharmaceutical industry and the health system, as well as the achievement of measures directly connected to savings in dealing with several aspects (time - efficiency, money - economy). Networking of institutions in the field of information on medicines and medical devices affects how efficiently the business of the Medicine and Medical Device Agency of Serbia (ALIMS) and health institutions, patients or the pharmaceutical industry is, which leads to a significant reduction in total costs and time saving. ALIMS was ready from the start to participate in the initiative to open data and thus enable that information on medicines and medical devices, and integration with other data, to get more value and become useful to other state bodies and institutions.

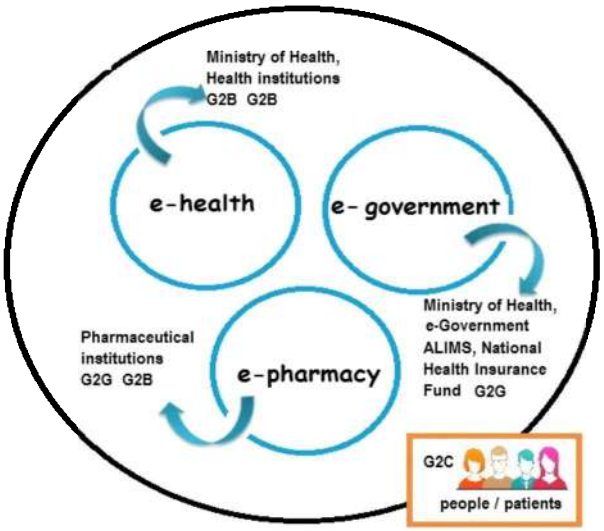


Figure 1: Models of e-business between eHealth, eGovernment and ePharmacy

3. METHODS OF DEVELOPING SOFTWARE IN E-GOVERNMENT

Methods of software design are specific strategies that propose and provide a set of notations which are used with the method (as a description of the process that should be used when monitoring methods , and a set of guidelines for the use of the method) (Budgen, 2004).
Some of the methods of design software are: object- oriented design, functionally - oriented design , design - oriented data structures and design based on components. This section will describe the methods, methodologies and software development models, which are used in e-government. Particular attention will be devoted to the life cycle of software and business intelligence, and SOA (Service Oriented Architecture) and BPM (Business Process Modeling). The methods of the life cycle of the attention will be devoted to a single method of software development process. The integrated framework, which will be displayed and used in this paper is based on the use of RUP methodology and agile methodologies, business intelligence with the principles of data mining and data warehousing, BMPL (Business Process Modeling Language) and UML (Unified Modeling Language) - notation and reengineering business processes. The main principles are incremental and iterative development, active participation of users, based on the development of models, testing and cooperation. The paper consolidated methods, techniques, standards and process models in the field of e-business and access to quality analysis, modeling and design of the portal system of the Serbian authorities. The life cycle of software can be considered through its processes, ie. activities that make this

process as well as through its models, methods and strategies. Software Life Cycle Processes are defined by a number of reasons, including increasing product quality, facilitating human understanding and communication, support process improvement, and support management processes. It also enables the automatic routing process and provide support for automatic execution. Various elements of the process can be defined by means of activities, products and resources. Software process is a set of activities, methods, practices, and transformations that are used to develop and maintain software and related products.Methods for software life cycle can be said to describe the process of software development through its individual operations or processes. Model describes the software life cycle phases that occur during software development. Software development process includes 5 stages: requirements specification, analysis, design, implementation and testing. Different methods of software life cycle models use different software life cycle.
The purpose of Business Intelligence (BI) is not just a collection, but also processing, analysis, visualization and use of information for business purposes, mainly in order to support business decisions. By definition, the term BI combines methodologies, technologies and platforms for data warehousing, OLAP (Online Analytical Processing) and data mining allow companies to create useful management information from the data on the operations, which are at different transactional systems and come from a variety of internal and external sources. BI is a set of tools and applications that enable the creation of a system for the collection, analysis and dissemination of business information, with the aim of making better business decisions (Kevin, 2007).

3.1. SOA and BPM

This subchapter focuses on SOA, where programming is based on the process approach and represents a higher step in the development of software engineering. Process oriented programming does not need to replace, but to complement existing approaches to programming, such as structural, component and object-oriented programming. SOA describes the concepts, architecture and procedural framework to ensure cost effective development, integration and maintenance of IS, through the reduction of complexity and stimulation of their integration and re-use. SOA does not represent a radically new architecture, but rather the evolution of the well-known distributed architecture and integration methods. SOA improves and expands the flexibility of previous integration methods and distributed architecture and focuses on the re-use of existing applications and systems, effective interoperability and integration of applications, as well as the composition of business processes through service secured applications. An important feature of SOA is the ability to implement the changes that will occur in the future, in a relatively simple and easy way. SOA is more than a set of technologies. It is not directly related to any technology, although they are often implemented using Web Services (WS). WS are the most appropriate technology for the realization of SOA. The most important concepts of SOA are (Emig, Weisser, Abeck, 2006):

- Services that provide business functionality and business value, that hide implementation details and are autonomous.
- Interfaces, through which users access the service. The interface defines a set of public service operation signatures and represents a contract between service providers and service users. The interface is separated from its implementation, the self-descriptive, and independent of the platform.
- Messages that specify the data to be exchanged, describe them in a manner independent of platform and language use patterns.
- Synchronous and asynchronous communication to call the service operations.
- Poor connectivity includes services that only show the necessary dependencies and reduce all kinds of artificial dependencies.
- Registers, where service providers publish services, while service users search registers to find the needed service.
- Quality of service marks attributes such as - security, reliable messaging, transactions, correlation, addressing.
- Composition of services into a business process (the most important SOA concept), providing support for business processes in a flexible and relatively easy way, as well as rapid changes of business processes with less effort.

BPM refers to the design, management and execution of the business process, and its strength lies in the unification and expansion of existing process oriented techniques and technologies. For business analysts, BPM means the perception of the organization as a set of processes that can be defined, which can be controlled, and which can be optimized. Instead of the traditional orientation, according to which parts of the operations of organizational units, BPM is oriented towards business, regardless of the organizational unit that are executed. For technical staff, BPM technology represents a group focused on defining, executing and monitoring process logic. Regardless of the different perspectives of both groups, and business analysts and technical staff, aim to improve business processes. BPM should be used only for applications that are process-oriented, respectively, which are: long-term, state kept in databases, most of the time waiting for the action to start the next activity and processes which are responsible for the management and coordination of

communication between different role of systems and people. Process applications need to meet at least part of the above characteristics. The reasons for the use of BPM are: formalization of existing processes, better understanding and incorporation of improvements in the business processes, more efficient execution of business processes from the use of BPM software, increasing productivity and reducing people's participation in the execution process, enabling people to solve.

4. DEVELOPMENT OF E-SERVICES AND E-SUBMISSION IN ALIMS

ALIMS is a public agency of the Republic of Serbia, whose work provides the services of issuance, renewal and amendment of licenses for medicines for human and veterinary medicine, as well as the registration of marketing authorizations for medical devices, quality control of medicines and medical devices that meet the requirements for efficiency, quality and safety. The vision of being a modern, efficient and socially responsible institution is conducted everyday by a teamwork of employees, which is based on four basic principles: social responsibility, leadership, trust and quality. Transparency of the work is reflected through the portal of ALIMS where they meet all the criteria of functionality, defining the guidelines for making Web presentations of the state administration.

ALIMS participates in the development of eGovernment portal RS. The functional area of e-services is enabled on the primary web page of the ALIMS site and contains a list of all names of e-services published on the portal of e-government.

The latest e-services "Downloading registry of medicines and medical devices" is set in 2015. State agencies and legal entities can retrieve the registry of medicines for use in human and veterinary medicine, as well as a registry of registered medical devices for which the ALIMS issued a marketing authorization, and the registration of medical devices in the Register of medical devices, with the use of a qualified digital certificate. The aim of this service is to download data on medicines and medical devices in digital, machine-readable formats that can be used for further work and use in other state bodies and legal entities, especially in the context of the development of the e-Health of the Republic of Serbia. Register of medicines and medical devices in the form of e-Service enable downloading of the codebook data on medicines and medical devices from the ALIMS database that are updated on a daily basis. E-service "Downloading registry of medicines and medical devices" enables downloading on a daily basis from the updated medicines register for use in human and veterinary medicine and medical devices registered in the register of MS, in digital, machine-readable, and open formats: .csv and .xls. Data on medicines and medical devices that ALIMS handed over to the state institution and legal entities on the eGovernment portal, are available for those with qualified electronic certificate, which allows authentication in order to ensure data protection using existing protection mechanisms. This way of downloading data is also conducting and updating records on persons who retrieve data, as well as the institutions that are interested in this information. The download process data is very simple. E-Government portal, onced logged in on by using a digital certificate, displays information about the owner of the digital certificate who has to state a reason for downloading data. This way ALIMS achieves more benefits for almost all sectors of society: new business and economic opportunities - turning data into economic systems at all levels and new innovative solutions - combining data from multiple sources, which then creates new values.

At the end of last year ALIMS has started a new project that will enable the integration of ALIMS and pharmaceutical industry, and includes e-submission request of clients in the pharmaceutical industry on the easiest way by selecting the appropriate eServices and completing the application form, which was given the opportunity to submit the attached documentation in electronic form with certain requirements. The basic idea of this project is to enable clients wishing to apply electronically. The vision of the project is to develop application forms for eGovernment portal where customers will be able to electronically fill patterns ie. customer requirements and deliver them electronically with all the accompanying documentation. The project titled "eSubmission" began in the middle of last year, with the plan to be completed by the end of August 2016. The project includes the development of 60 eServices ALIMS and allows the pharmaceutical industry to operate without physical arrival at the location ALIMS by applying for the appropriate electronic service ALIMS. This is reached by using a digital certificate, which provides training and leads to the pharmaceutical industry when it comes to the development and application of informational technologies and provides additional support for the development of the same in the Republic of Serbia. For the future of e-government and e-business in regulation of medicines in Serbia it is important to use the experience of other countries, with consideration of their successes and failures, as well as adapting this knowledge characteristics of socio-economic environment in Serbia. Equally important is the cooperation with the Ministry of Health and the Government of Serbia, because in this way there is a solution that information subsystem of e-business in regulation of medicines integrates into the overall IS of e-government of Serbia leading into single architecture, which can be reached by working together and forming an agreement of all stakeholders, starting from the government, through the non-governmental sector, academic institutions, to the citizens themselves.

This chapter shows model and life cycle of the process (Figure 2).

SOA is implemented using WS as follows:
- WS that enables the transfer of all customer requirements with the appropriate electronic services from eGovernment portal to the internal ALIMS network (external eGovernment portal to DMZ at ALIMS),
- WS that enables the transmission of the same client requests and integration with electronic document management system of ALIMS (DMZ at ALIMS to internal, production EDMS at ALIMS).

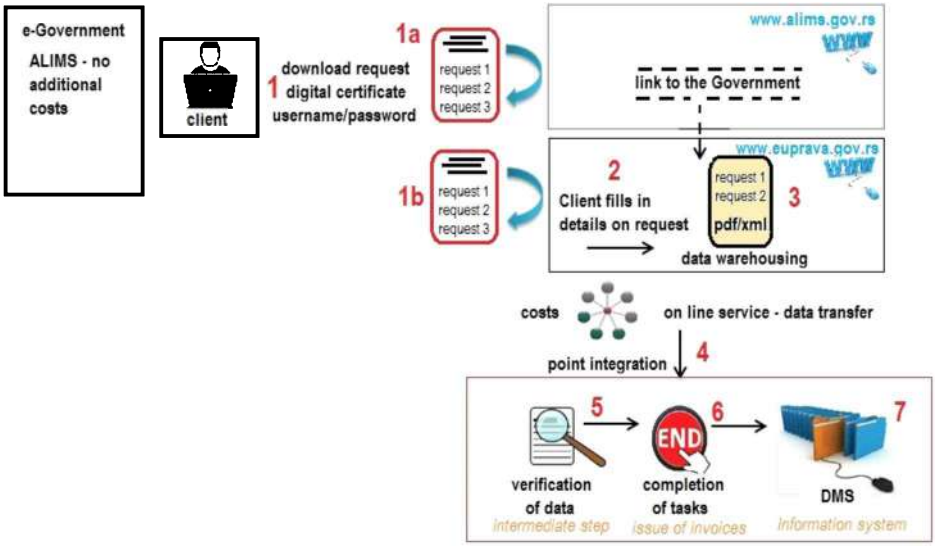


Figure 2: Model and life cycle process

The life cycle process is:
1. Requests for clients are located on the ALIMS site linked with the eGovernment portal. Link on each request is transferred to the appropriate eGovernment services portal (1a) .The client only with a valid digital certificate has the ability to fill the requests (on the eGovernment portal).
2. Client selects appropriate eService and fills request directly using the application, which is located on the eGovernment portal.
3. Data is stored with the request in the database on the eGovernment portal, which can be accessed by the authorized person. The document, which is formed as a client request must contain the e-signature, and is in pdf and xml format.
4. Online WS on the eGovernment portal then transfers the request to the defined system integration point, which is server located in the DMZ at AliMS. Server in the DMZ at AliMS automaticly passes the requests to the internal EDMS (Electronic Document Management System).
5. In the system EDMS data verification is done by the colleagues that work on Acceptance of client requests.
6. After verification, acceptance and ending task, there shall be issued a pro-forma invoice to the client and confirmation of receipt, which are sent by e-mail or otherwise electronically or physically considering the fact that the client has to come and bring the documentation also.
7.Flow in the process takes place in the information system of the ALIMS-EDMS
List of e-services is divided into three segments: human medicines, veterinary medicines and medical devices,in the following way with total of 62 forms used:
• Human Medicines (23 Forms): Application for marketing authorization (6), Application for the import of unregistered medicines (2), Application for the approval of clinical trials (4), Application for the SPC, PIL and Labeling (3), Application for approval of promotional materials for the medicines or medical devices (1), Application for issuing the technical opinion (1), Application for the issue of categorization of medicines (1), Application for reporting doubts about the quality of the medicine (1), Application for the quality control (1), Application for supplementary documentation (1), Application for the suspension of request (1) and Application For partial suspension of the request or changes the marketing authorization grouped variation request (1).
• Veterinary medication (25 Forms): Application for marketing authorization (6), Application for the import of unregistered medicines (4), Application for the approval of clinical trials (4), Application for veterinary SPC, PIL and Labeling (3), Application for approval of promotional materials for the veterinary medicines and medical devices (1), Application for issuing the technical opinion (1), Application for the issue of categorization of veterinary medicines (1), Application for reporting doubts about the quality (1), Application for quality control (1), Application For supplementary documentation (1), Application For the suspension of request (1) and Application For partial suspension of the request or changes the marketing authorization grouped variation request (1).

• Medical devices (14 Forms): Application for for registering the medical device in the Register of medical devices (1), Application for import of unregistered medical devices that are not registered in the Register of medical devices (2), Application for authorization or notification of clinical testing of medical devices (1), Application for promotional material for medical devices (1), Application for issuing an expert opinion (1), Application for the categorization of medical devices (1), Application for reporting adverse reactions to a medical device usage (5), Application for reporting doubts about the quality or deviations from the standard quality of the medical devices (1) and Application for quality control (1).

5. ANALYSIS

The survey relating to the testing of e-readiness of the pharmaceutical industry for the project of e-submission was implemented in August 2015. The questionnaire was sent to all pharmaceutical institutions with a term of one month for an answer. Of the total number of participants, the survey was completed by 32% of participants. Most of the participants are familiar with the concept of electronic storage of data / documents and with the guidelines on the subject of filing documents. The Agency's intention to move to an electronic system of communication was supported the most. The proposal to organize workshops and conferences on this subject in order to inform and educate the clients on time, in order to better and more successful transition to the new system of application was also well supported. Figure 3. shows some of the results of that survey.

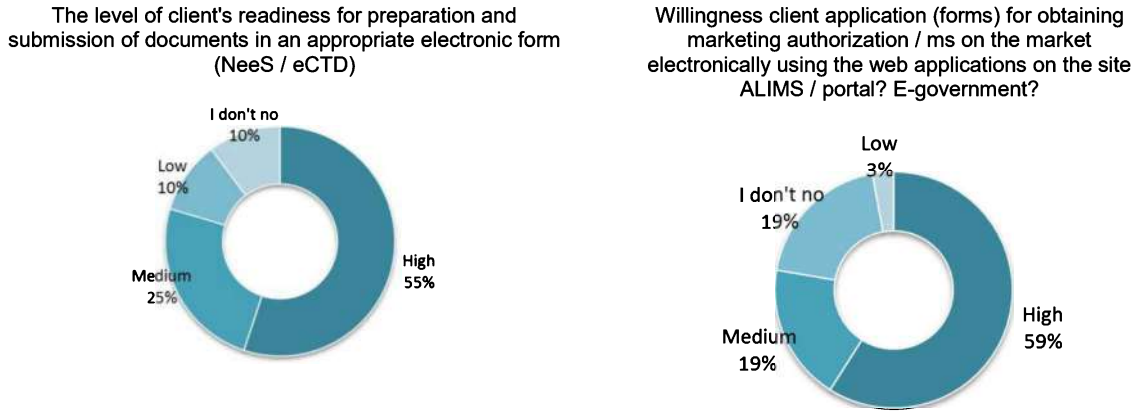


Figure 3: The testing of e-readiness of the pharmaceutical industry in Republic of Serbia

6. CONCLUSION

The methodology for the development of e-services, methods for modeling and analysis of business processes and reference model of e-business in regulation of medicines as one of the subsystems of e-government process metamodel in the context of e-government, life cycle business system design on the e-government network web portal and e-business in regulation of medicines, are the main scientific contributions of this work. Developing web software for e-business development in regulation of medicines, as one subsystem of the e-government implemented in Serbian Agency are the main professional contributions to this work. Improving e-business in regulation of medicines, as a subsystem of e-government would have to aim: the development of interfaces and support for model specification systems through interaction with citizens, the economy, healthcare, pharmaceuticals and other public authorities, support the adopted modeling standards, integration of e-business in regulation of medicines, the e-government, e-health and e-pharmacy in Republic of Serbia, application of methods and techniques of life cycle business model which are presented in the thesis, agile methods and application of SOA, BI, and BMP. The "e-filling clients' requests ALIMS" will enable the integration of ALIMS with pharmaceutical industry and provide electronic submission of customer requirements, thus achieving significant savings for ALIMS as for the pharmaceutical industry in the RS. In this way ALIMS fulfills its mission - to promote and improve the health of people and animals, as well as to contribute to the realization of the fundamental human right to access to quality, safe and effective medicines and medical devices. The development of e-business in regulation of medicines, as a subsystem of e-government of the Republic of Serbia, provides a unique environment for communication, better information about medicines, education via Internet for health workers, as well as the more efficient operations in the healthcare and pharmaceutical industries and the realization of the concept of e-government in segment which regulates medicines and medical devices areas.

REFERENCES

Budgen, D., (2004). *Software Design.* Addison-Wesley

Ciric, V., Vlajic, S.,(2003). The methods of software development. Belgrade: FON.

Emig C., Weisser J., Abeck S. (2006). *Development of SOA-Based Software Systems – an Evolutionary Programming Approach.* IEEE Computer Society

IEEE Computer Society Professional Practices Committee. *SWEBOK, Guide to the Software Engineering Body of Knowledge.* The Institute of Electrical and Electronics Engineers, Inc. (2004).

Ivkovic, M., Radenkovic, B., (1998). I*nternet and contemporary business*. Belgrade: "Mihajlo Pupin"

Pedro, G. Gonnet., (2001). *The Future of Informatics as Scientific Discipline*. upgrade the European Online Magazine for the IT Profesional. Vol II, No. 4

Project Plan of ALIMS od e-Business., (2015). Medicines and Medical Devices Agency of Serbia.

Quinn Kevin R. (2007). *Establishing a Culture of Measurement – A Practical Guide to Business Intelligence*: Information Builders.

Vaskovic, V., (2008). *E-business in e-government.* Belgrade: FON

INTERNET OF THINGS IN E-HEALTH: APPLICATION OF WEARABLES FOR STRESS MANAGEMENT

Branka Rodic Trmcic *[1], Aleksandra Labus[2], Bozidar Radenkovic[2]
[1] Medical College of Applied Studies in Belgrade
[2]Faculty of Organizational Sciences
*Corresponding author, e-mail: branka@elab.rs

Abstract: *In this paper, we investigate the potential of the Internet of Things in health and well-being. One of the most popular component of well-being is stress management and many research attentions have been focused on relationship that exists between stress and different contexts. In this paper, the model of mobile health for well-being based on wearable computing has been introduced. It allows monitoring of vital parameters and environment parameters that are of importance for the identification of stress or its predictors. As a support to the wearable system, a mobile health application for well-being was developed, featuring relaxation content. Mobile health application for well-being with relaxation content should minimize the excitement and impact on reducing stress. The main goal of research in this paper was measurement of vital parameters during students' term papers defense. Results shows differences between measured vital parameters through wearable system before and during students' defense of term papers.*

Keywords*: e-health, mobile health, Internet of Things, wearable computing, mobile technologies, well-being, stress management*

1. INTRODUCTION

The use of Internet of Things in health in different contexts is not a novelty, and the idea of constant monitoring of well-being is becaming more and more popular. Wearable sensors in health care allow continuous monitoring of relevant vital parameters during every day human activities.
Collected data can be distributed to health gateways or remote systems where they can be processed and analyzed based on algorithms or expert knowledge. Such expertise may indicate the occurrence or symptoms of certain illnesses or stress.

Many life situations can lead to stress-induced excitement today. Heart starts beating fast, face changes and sweating starts. Most obvious example are public speeches (Kusserow, Amft, & Tröster, 2013). Student who defending term paper, taking exam orally or defending thesis also has public onset.
Stress that occurs on those occasions can significantly reduce the quality of speech and increase the possibility of making mistakes. If repeated several times over a longer period can affect the changes in student's behavior or his attitude towards learning and future career (Sohail, 2013).

By measuring certain vital parameters in students, such as heart rate, skin conductivity etc. one can observe their variations in different contexts (waiting for the exam, while defense term paper, taking exams, etc.).
The source of stress for students can be reached through cross-referencing, comparison and analysis of measured data over a longer period.
Testing the influence of mobile health application for well-being in the reduction of stress can serve to build model-pattern of behaviour that can be used to predict the same or similar reactions of the same population in the future (Dragon, et al., 2008), (Shen, Wang, & Shen, 2009).

The research aims of this paper are the concepts of the Internet of Things in the area of electronic health, wearable computing in different areas of well-being, as well as technical and technological setups necessary for the realization of Internet of Things solutions.
Mobile health system based on wearable computing for stress management has been developed. System will measure presence of stress in students during defense of term papers. Mobile application for well-being with relaxation content should increase stress in students.

2. INTERNET OF THINGS IN E-HEALTH

With the expansion of the Internet and the introduction of modern ICTs, a modernization of almost all aspects of business in society took place. Electronic health or e-health originated as the crossroads between health

informatics, public health, and processes related to providing healthcare and to the information generated and transferred through the Internet and related technologies (Eysenbach, 2001).
According to the definition of the World Health Organization, electronic health (eHealth) denotes the use of information and communication technology in healthcare (World Health Organization, 2015).
According to the definition of the European Commission (European Commission, 2015), electronic health is defined as the application of information and communication technologies for fulfilling the needs of citizens, patients, healthcare professionals, healthcare providers and health policy creators.

The term mobile health (mHealth or m-health) is an area of eHealth. Mobile health is a term that is used in providing health and medical care as well as in public health, with the support of mobile devices (World Health Organization, 2011). This term also covers healthy lifestyle applications that, in a direct or indirect way, improve the health and quality of life of individuals. Such applications are often connected to medical devices or sensors (watches, bracelets, jewellery, etc.).

Market and performance of mobile phones has seen such advances that tens of millions of people who previously had no access to a phone or a computer, use cell phones nowadays, which provide them communication and data transfer.
Smartphones allows smooth transfer of data such as multimedia content, high-resolution images, voice, etc.
In Serbia 91.4% of population, own mobile phone and more than 60% Internet connection (Statistical Office of the Republic of Serbia, 2016).
Mobile devices have a wireless Internet connection that allows them to connect anywhere and continuous access to data. Today's smartphones have a number of sensors such as gyroscope, accelerometer, GPS that measures specific user activities. In addition, they are unavoidable in the development and deployment of mobile applications for well-being.
The Internet of Things represents a network of physical objects connected using wireless or wired Internet networks, which contain built-in sensor technology, allowing for interaction with the interior state of the smart device itself or with the external environment. Devices collect and exchange information directly between themselves, with other devices or through a cloud, where it is possible to collect, store and analyse data (Chouffani, 2015).

Wearables are one of the Internet of Things technologies. Wearables are small electronic devices, which are often composed of one or more sensors and have computing capabilities (Salah, MacIntosh, & Rajakulendran, 2014). Wearables are objects which are worn on the body, e.g. on the head, foot, hands, wrists or waist, they can be built into clothes, or they can also be clothes themselves (Mann, 2014). They can take the shape of watches, sunglasses, clothes, contact lenses or even a very modern jewellery. Wearable devices are portable, which allows for the comfort and mobility of those wearing them.
Measurement of vital parameters are possible during users' normal daily activities, regardless the location of the user, and the data can be transferred to a remote server, health gateway or mobile device, where its further analysis and distribution will be performed.

2.1. Wearable computing in eHealth

The promotion of healthy lifestyles and well-being, and their impact on health, has encouraged people to take part in managing their health.
This led to the fact that in recent years, there is increased interest in wearable medical devices, in research area, as well as in health activities (fitness, wellness, equipment for people with disabilities, dermatology, etc.) (Ranck, 2012).
As many technologies are available nowadays (micro technologies, telecommunications, energy efficient devices that consume minimal amounts of energy, new fabrics and flexible sensors), it is possible to design new and modern devices. That devices are usually very comfortable, modern and safety for users and users easily accept them and wear them in different occasions.

Stress is main and leading challenge in modern society. Stress activates the sympathetic nervous system, and its activation causes different reactions in the human body as:

- Heart rate increased. Heart rate is the number of heartbeats per unit of time, usually measured at the wrist. Heart rate shows the health condition of a person and can give early indication of heart diseases.
- Sweeting. When a person is under tension or influenced of certain emotions, sweat glands become more active and secrete more fluid through skin.
- Muscle tension. Muscle tension, facial expressions and eye blink rate increase while person is under tension or influenced of certain emotions.

Long-term repetitions of such manifestations in any population are a frequent predictor of other health conditions and disorders, and even of mental illnesses.
Among students, there is a frequent onset of stress whose sources lie in a separation from home, change in habits, short deadlines, social environment, long waiting in lines etc., all of which can significantly contribute to a reduction in academic performance (Sohail, 2013).
The presence of stress can be identified by measuring various vital parameters of the user, as well as measuring the parameters of the environment that may have an impact on the change in the values of the vital parameters.
Many studies are dealing with stress identification with different type of sensors or their combination.

Galvanic skin response (GSR), also known as electrodermal response (EDR), psychogalvanic reflex (PGR), or skin conductance response (SCR), is a method of measuring the resistance of the skin.
Skin conductivity is one of the signal often used in lie detectors.
Fear, anger, startle response, orienting response and sexual feelings are all among the emotions that may produce similar GSR responses (Mohankumar, 2010).
When person is in its calm state, skin has high resistance and low conductivity. If the blood flow to the skin, when stress is present, blood vessels becomes leaky and water leaks out to form the sweat. This mechanism is important because it cools the body skin through the evaporation of sweat. When this happens, the resistance of the skin decreases to be capable to remove water from itself. At the same time, as the skin's resistance and conductivity are directly proportional, the moist skin increases electrical conductivity.

The sensor for conductivity is involved in many studies that deal with the identification of stress. In the study (Picard & Scheirer, 2001), a skin conductivity sensor was applied as a wearable device for the identification of a person's excitement while listening the seminar speakers. LED light simulated a change in values of GSR.
Following study (Zubair, Yoon, Kim, Kim, & Kim, 2015) also performed detection of mental stress during everyday activities with wearable sensor for GSR. In a case of changed values user, get alert through mobile phone in order to manage the stressful situation.
In study (Sano & Picard, 2013) a skin conductivity sensor and existing mobile phone features (calls, SMS, location services) were used for stress detection. The results were compared with traditional research techniques for stress detection.

Heart rate is one of more certain indicators of the presence of a change in mood or stress, and it is useful to monitor it in actions of health prevention.
A heart rate measurement system is often implemented in devices related to sports (Suunto, 2015), fitness (BASIS Science, 2015), and in stress management (Millings, et al., 2015).

Heart rate sensor is one of the most common sensor in stress management. In (Kusserow, Amft, & Tröster, 2013) a heart rate sensor was implemented together with a skin conductivity sensor, accelerometer and temperature sensor in a familiar natural context – public appearance of PhD students in front of an audience, where significant variations in the values of measured vital parameters were observed.

SpO2 stands for peripheral capillary oxygen saturation. Pulse oximetry is a method used to measure the concentration of oxygen in the blood. SpO2 can be measured by pulse oximetry by emitting and then absorbing a light wave passing through blood vessels (or capillaries) in the fingertip. Normal SpO2 values vary between 95 and 100% (Withings, 2015).

Certain parameters of the environment can affect the individual feels like or a change in his behaviour. Therefore, it is important to monitor them in certain contexts with appropriate sensors. Some of the parameters that may have an impact on well-being during exams or defences of term paper or thesis are noise levels, room temperature, air humidity, the amount of oxygen and others.

2.2. Model of mobile health for well-being based on wearable computing

Model of mobile health for well-being based on wearable computing consist of wearable system for monitoring of vital parameters, system for environment parameters measurement and Android application for well-being with relaxing content, and services for connecting components, hosts and users.

Implemented wearable system and system for measurement of environment parameters consists of heart rate sensor and pulse oximetry (Pulse Oximeter Contec CMS 50D+), GSR sensor (Grove - Galvanic Skin Response – GSR), noise level sensor, CO and temperature sensor.

The system was implemented using the Arduino microprocessor and the Raspberry Pi microcomputer. The implementation on these devices was carried out using the *Python* programming language and the *php* script language.
The Android well-being application was created in the Android Studio 1.2.1 programming environment, using the Java programming language. Contents that students-assistants found to be relaxing were implemented in the app: funny sport scenes, beautiful nature photos, relax music (SPA, relax music, Zen, Chill out etc.). The content was taken from YouTube channel.

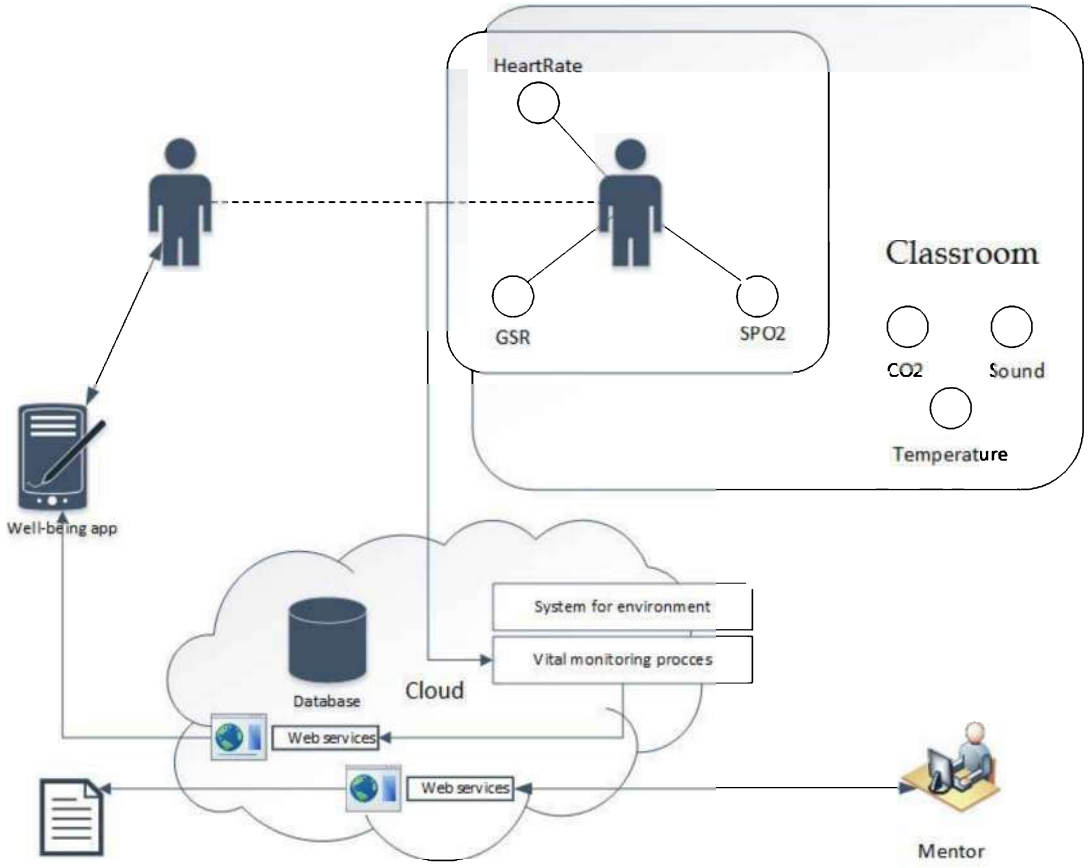


Figure 1: Model of mobile health for well-being based on wearable computing

Since a high level of noise or temperature can cause concentration issues, the values are measured using a noise and temperature sensor and the obtained information is analyzed.

3. METHODOLOGY

The aim of research is measurement of vital parameters during students' defense of term papers, as well as determining the differences between measured GSR values, oxygen saturation and heart rate through implemented wearable system before and during defense of term papers.

The students were supposed to defend term papers in e-business, i.e. Internet of Things in e-health, and they were familiar with the concept of the wearable computing. Research took place in April 2016 at the E-business Laboratory of the Faculty of Organizational Sciences, University of Belgrade. The measurements were conducted over one day.

3.1. Experimental protocol

After arrival, respondent was situated in a pleasant room, connected to sensors (heart rate, SPO2 and GSR). Heart rate sensor was attached on forefinger, GSR sensor on middle and ring finger on the palm side of the left hand. After that, the respondent was given a general questionnaire.
After completing the tests, respondent was given a tablet with a pre-installed Android application for well-being with relaxation content and short instructions on how to use it. The respondent had 15 minutes to relax and use the application content. During the use of the mobile application, the duration of the use of the application and the content browsed by the user were tracked. The obtained values of vital parameters for the respondent were recorded.

The test began after the 15-minute of relaxation. Three examiners entered the room. The test consisted in three parts: first part – preparatory notes, second part – presentation and third part – questions and math.
The test began when one of the examiners read the following text to the respondent: "You are expected to prepare notes for the presentation of your term paper within five minutes, and then to orally present your paper within exactly five minutes. Your presentation will be recorded. The time starts now!"
During the entire test, vital parameters (heart rate, SPO2 and GSR) were measured as well as environment parameters. After the time of five minutes was up, an examiner took the paper with preparatory notes from the respondent and asked him/her to start with second part - defense of term paper within five minutes.
If respondent paused for about 15 seconds, he/she was told to continue as well as remaining time until the end of that part of the test. After the 5-minutes defense of term papers an examiner asked the respondent five questions related to the paper (approximately 2.5 minutes), and then the mathematical part of the exam started, lasting for approximately 2.5 minutes. The respondent was asked to count backwards, subtracting 13 from 1022. If the respondent made a mistake, they were asked to start from the beginning. They were informed of that by saying: "You are wrong! 1022."

3.2. Participants

The sample consist of students of Faculty of Organizational Sciences. Six students successfully finish the research test. Self-constructed general questionnaire was created for the purpose of this research. The respondents filled it out in the first phase – pre-test. General questionnaire consisted of demographic questions about the respondent and was not anonymous.
Table 1 shows the descriptive statistics of the sample.

Table 1: Descriptive statistics of the sample

Characteristic	Gradation	Frequency	Percentage (%)
Sex	Male	3	50
	Female	3	50
Age group	19-21	0	0
	22-24	4	66.7
	More then 24	2	33.3
Smoker	Yes	2	33.3
	No	4	66.7
Physical activity	Regularly	2	33.3
	Occasionally	4	66.7
	Never	0	0

3.3. Data analysis

Microsoft Office Excel was used to analyse data and interpretation. During the analysis process, frequencies, percentage were used. Data are presented descriptively, in tables and graphs.

4. RESULTS AND DISCUSSION

4.1. General stress level

The measured values show pulse variations during the test, compared to pre-test period. Sampling rate of GSR data was 0.2 Hz and for heart rate was every four readings per one beat.

Figure 2 shows mean values of measured heart rate in respondents.
We compared the average values of the pulse of the respondents in the pre-test and during the test. The average value of the pulse during the test increased by 13 heartbeats.

Figure 2: Mean of heart rate during pre-test and test period

Average relative change value of the pulse during the test compared to the period before the test in the subjects is shown in Table 2.

Table 2: Percentage increase in heart rate during the test compared to the period before test

Respondent	***1***	***2***	***3***	***4***	***5***	***6***
Heart rate increase (%)	11.6	8.1	22.4	15.9	26.2	15.1

Average measured GSR values in most respondents' shows variability, i.e. increase in values during the test according to period before test when respondents waits for testing.

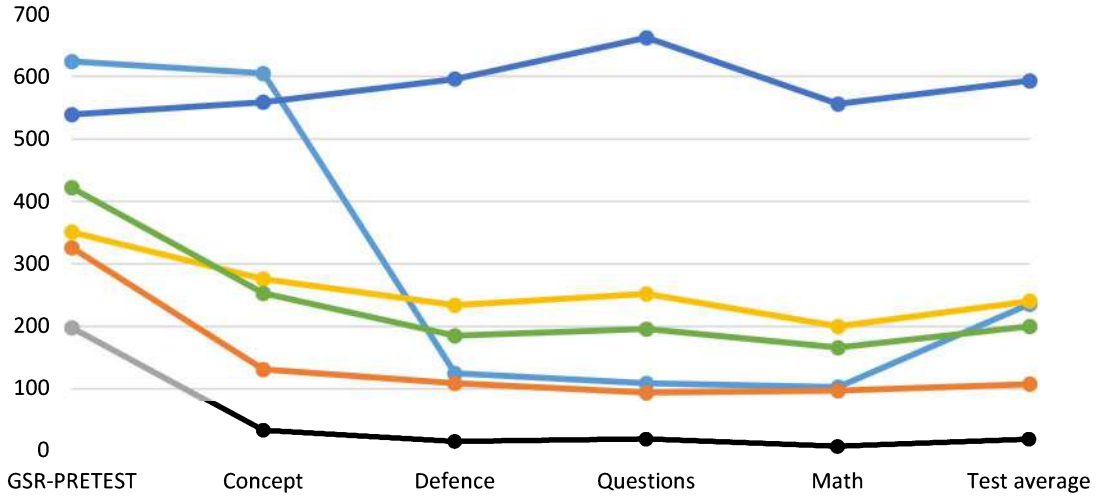


Figure 3: Average values of GSR (resistance changes) during different parts of testing

Reduction in value or drop in resistance begins at the start of the test, where respondents are writing the concepts, then while defense term paper. A slight increase occurs when the interviewer ask questions related to the topic, and continuous decline during the mathematic test.

Table 3 presents the relative GSR value change during the test compared to the period before the test in respondents.

Table 3: Relative changes in the value of GSR during the test compared to pre-test period

Respondent	***1***	***2***	***3***	***4***	***5***	***6***
GSR changes (%)	62	67	91	31	-10	53

Figure 4 shows a schematic of receiving signals through sensors GSR.

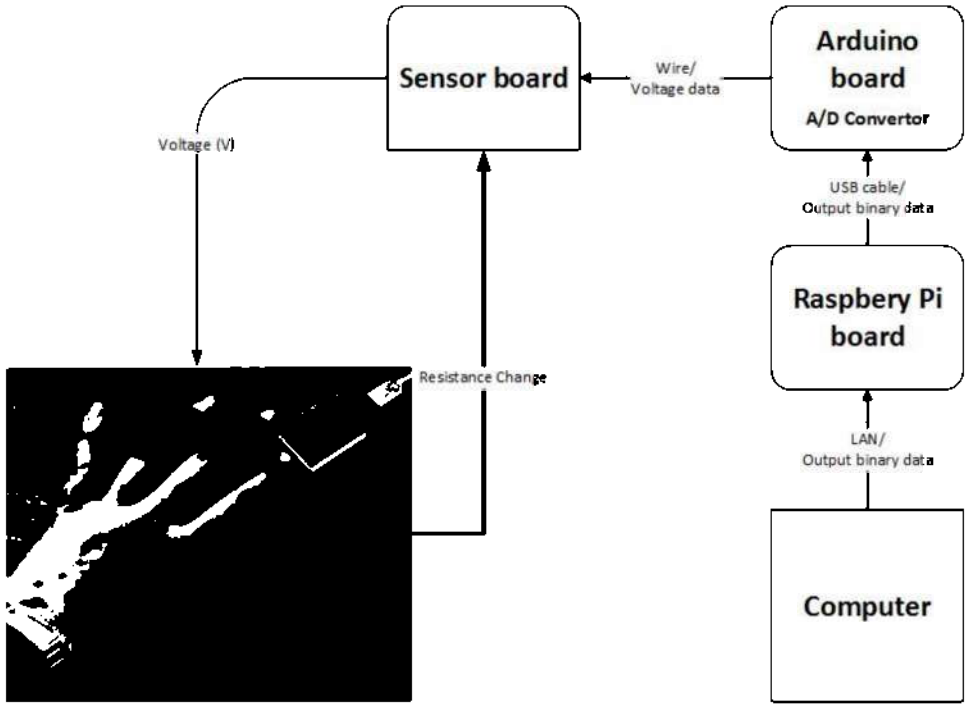


Figure 4: Path of the signal from GSR sensor to computer screen

Skin conductivity is expressed in μS (microsiemens), but output value from the sensor and microprocessor is resistance change. The measurement of resistance changes were measured with resistors of different values. Gain values were compared with output binary values from Arduino processor. Based on calculated values, we come to the exponential equation:

$$y = 125.02e^{0.0036x}$$

Calculated correlation coefficient is $R^2 = 0.9449$.

Based on the state that resistance = 1/conductivity, where the conductivity of the skin is obtained and expressed in μS, skin conductivity is shown on Figure 5.

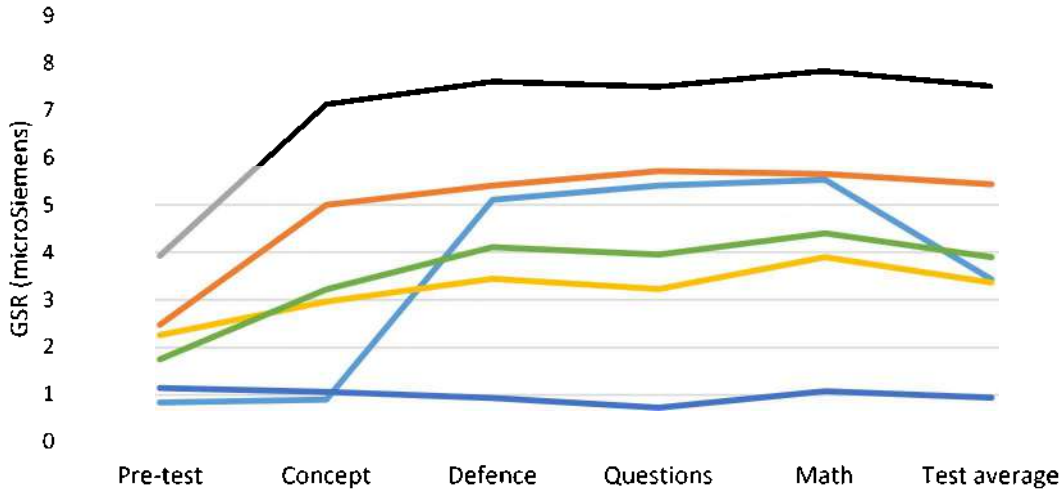


Figure 5: GSR values in microsiemens in period pre-test and different phases of testing

4.2. Well-being app usage

The average time of mobile health application for well-being with relaxation features use was 13 minutes and 1 second.

The overview of time spent on watching different application content is given on Table 4.

Table 4: Distribution of time spent at different contents of well-being application

Content	Total of time spent on content (mm:ss)	Average time on content (mm:ss)
Fun sport	33:22	02:05
SPA music	34:50	01:56
Relax photo	09:52	01:14

The longest time respondents spent listening to SPA music, followed by watching videos of funny sport scenes. Shortest time were spent watching relax photos. The longest average stay was on the funny clips from the world of sport.

4.3. Environment parameters

Sound level, air temperature and CO were measured in the environment. During the test, CO is not registered. Temperature values and sound levels are shown in Table 5 and 6, respectively.

Table 5: Mean of environment temperature values during test

Respondent	***1***	***2***	***3***	***4***	***5***	***6***
Temperature (°C)	28	28	28	28	29	27

Table 6: Mean of sound values during test

Respondent	***1***	***2***	***3***	***4***	***5***	***6***
Sound (dB)	41	41	40	41	41	41

Both, temperature values and sound volume were approximately equal in all subjects. The temperature values were higher than comfort level of room temperature that is around 20 to 24 °C. For a proper assessment of comfort in classroom, it is also necessary to measure the air humidity.

5. CONCLUSION

The collection of data of stress and stressors among students during the examination of their knowledge is a challenge. Each individual reacts differently to stressful events. In addition, many factors affect how a person will behave, or have a stressful event during the observation. In this survey, we examined changes in GSR and heart rate during the test in relation to the period prior to testing. The result indicates the existence of an increase in the value of the heart rate during the test compared to the period before the test. GSR values indicate changes in terms of reducing the resistance or increasing the conductance of the skin that indicates sweating due to intense emotional states.

Future research, in addition to measuring vital parameters, have to be based on other factors that could affect the response in a particular context. Collecting data in a variety of life activities of the respondents can reach steady pattern of behavior and expected reactions in the environment such as the university.

REFERENCES

BASIS Science. (2015, November 02). Retrieved from BASIS: http://www.mybasis.com/

Chouffani, R. (2015, April 25). *Can we expect the Internet of Things in healthcare?* (TechTarget) Retrieved June 2015, from http://searchhealthit.techtarget.com/feature/Can-we-expect-the-Internet-of-Things-in-healthcare

Dragon, T., Arroyo, I., Woolf , B. P., Burleson, W., Kaliouby, R., & Eydgahi, H. (2008). Viewing Student Affect and Learning through Classroom Observation and Physical Sensors. In B. P. Woolf, E. Aïmeur, R. Nkambou, & S. Lajoie, *Intelligent Tutoring Systems*, 29-39. Berlin: Springer Berlin Heidelberg. doi:10.1007/978-3-540-69132-7_8

European Commission. (2015). *Policy.* Retrieved December 27, 2014, from http://ec.europa.eu/health/ehealth/policy/

Eysenbach, G. (2001). What is e-health? *J Med Internet Res, 3*(2), 20.

Kusserow, M., Amft, O., & Tröster, G. (2013). Monitoring Stress Arousal in the Wild. *Pervasive Computing, IEEE, 12*(2), 28-37. doi:10.1109/MPRV.2012.56

Mann, S. (2014). *Wearable Computing. In: Soegaard, Mads and Dam, Rikke Friis (eds.). "The Encyclopedia of Human-Computer Interaction, 2nd Ed.". Aarhus, Denmark: The Interaction Design Foundation.* Retrieved June 03, 2015, from https://www.interaction-design.org/encyclopedia/wearable_computing.html

Millings, A., Morris, J., Rowe, A., Easton, S., Martin, J. K., Majoe, D., & Mohr, C. (2015). Can the effectiveness of an online stress management program be augmented by wearable sensor technology? *Internet Interventions*. doi:10.1016/j.invent.2015.04.005

Mohankumar, D. (2010, December 12). *Galvanic Skin Response.* Retrieved from Electronics hobby: https://dmohankumar.wordpress.com

Picard, R. W., & Scheirer, J. (2001). The Galvactivator: A Glove that Senses and Communicates Skin Conductivity. *In Proceedings of the 9th International Conference on HCI*, 1538-1542.

Ranck, J. (2012). *The wearable computing market: a global analysis.* San Francisco: GigaomPRO.

Salah, H., MacIntosh, E., & Rajakulendran, N. (2014). *Wearable Tech: Leveraging Canadian Innovation to Improve Health.* Toronto: MaRS Market Insights.

Sano, A., & Picard, R. W. (2013). Stress Recognition using Wearable Sensors and Mobile Phones. *2013 Humaine Association Conference on Affective Computing and Intelligent Interaction*, 671-676. IEEE. doi:10.1109/ACII.2013.117

Shen, L., Wang, M., & Shen, R. (2009). Affective e-Learning: Using "Emotional" Data to Improve Learning in Pervasive Learning Environment. *Educational Technology & Society, 12*(2), 176-189.

Sohail, N. (2013). Stress and Academic Performance Among Medical Students. *Journal of the College of Physicians and Surgeons Pakistan, 23*(1), 67-71.

Statistical Office of the Republic of Serbia. (2016, April 20). *Usage of information and communications technologies.* Preuzeto sa Statistical Office of the Republic of Serbia: http://webrzs.stat.gov.rs

Suunto. (2015, November 01). *SUUNTO Foot Pod Mini*. Retrieved from http://www.suunto.com

Withings. (2015, October 15). *Heart Rate and SpO2 Measurement*. Retrieved from Withings Inspire Health: https://withings.zendesk.com/

World Health Organization. (2011). Global Observatory for eHealth. mHealth: New horizons for health through mobile technologies: second global survey on eHealth. Global observatory for eHealth series. *Volume 3.* Geneva: WHO.

World Health Organization. (2015, March). *Trade, foreign policy, diplomacy and health*. Retrieved from World Health Organization: http://www.who.int/trade/glossary/story021/en/index.html

Zubair, M., Yoon, C., Kim, H., Kim, J., & Kim, J. (2015). Smart Wearable Band for Stress Detection. *5th International Conference on IT Convergence and Security (ICITCS)*, 1-4. Kuala Lumpur: IEEE. doi:10.1109/ICITCS.2015.7293017

AN APPLICATION OF INTERNET OF THINGS: MEASURING TRAFFIC FLOW

Ivan Jezdović*, Aleksandar Ivković, Sanja Matejić
Faculty of Organizational Sciences
*Corresponding author, e-mail: ivan@elab.rs

***Abstract**: This paper shows an example of an application of IoT for measuring traffic flow. A model of measuring traffic flow based on IoT was shown. An application of IoT is developed in aim to measure traffic flow in real time. A web application for tracking statistical data is shown. The device that follows the sound and registers the number of vehicles that passed is shown. This web application should enable detection of traffic jam and sending notification about alternative routes to drivers. It can be used as a mobile application also. It is also possible to develop system that will send SMS messages and report all users where is traffic jam and ensure them that they will not be part of that jam. The example of implementation is shown by using sensor which measures traffic flow in real time. After the processing, all statistical data can be seen through developed web application.*

***Key words:** internet of things, smart traffic, traffic security, traffic flow, traffic management, web application*

1. INTRODUCTION

With every day number of people living in a city is increasing. Current estimations say that 50% of world's population lives in cities. Today's cities are not projected for these huge amounts of people. Streets are narrow, infrastructure is old, and systems for managing almost do not exist. With the advent of Internet, microcomputers, sensors and actuators it came to accomplishing all necessary conditions for building smart cities (SAS, 2016).

Smart cities are cities which have their own information systems. These systems do different things, from managing traffics to managing hospitals and schools. These systems are connected with each other and it is possible to control all of them from one place. Elements of smart cities are: smart lightning, smart system for trash removal, system for air analysis, smart traffic and many others. It is possible to implement street lightning which turns on only when somebody passes by and in this way saving a lot of energy. Instead of management vehicles (trash removal vehicles) which pass by buildings every day to remove trash randomly and emptying trash cans that are not really full it is possible to develop system that informs workers when trash cans are full. System for air analysis can track air quality and inform people who need these information which parts of the city they should avoid. Important part of smart cities is efficient traffic management (IBM, 2016).

Traffic management is a problem that lots of cities have deal with. Many cities are trying to find a solution to improve public transportation and provide better services inside the cities with smart traffic signs. Responsible for highways also are trying to find new ways how to ensure efficiency to the passengers on long journeys as well as efficient transportation of goods. They are also trying to reduce traffic jam with new parking system. Smart traffic increases capacity, pleasure of travellers and ensures transportation from one to another place as safe as possible. Local police, emergency services and other government organizations can use these networks of sensors to get a quick look about situation in the city, so they could help and milder crowding on the roads, but also quickly react to the accidents.

The model of measuring traffic flow is developed that should enable collecting traffic data in real time. A web app should enable improving traffic flow, reducing delays, increasing security and improving ecological situation. Collected data are shown in real time, so that each change on the road is spotted immediately. With good analysis of these data it is possible to improve traffic flow, reduce delays, increase security and ecological situation.

2. LITERATURE OWERVIEW

Smart traffic includes data processing that sensors collected in the streets and inside the vehicles (Galán-García, Aguilera-Venegas and Rodríguez-Cielos, 2014). Some cities already use different analysis for prevision and traffic reduction. This kind of system helps drivers and authorised personnel. Drivers use different mobile and web applications to detect and avoid traffic jams. Authorised personnel for traffic use collected data to determine where it is needed to include new bus lines or change the traffic lights working order.

One of the cities that invests in smart traffic implementation is Singapore. Singapore adopted intelligent transport strategy. It is one of the cities in which the least traffic congestion occur, with an average speed on main roads of 27km/h, compared to an average speed in London which is 16km/h and Tokyo where is that speed only 11km/h (Batty *et.al.*, 2012). City uses electronic pay toll system where price varies in relation to the traffic flow. Each taxi vehicle has a GPS system which sends data about traffic conditions in the city. Information from all these systems are sent to the main control centre which merges data and provides information about traffic flow in real time.

Intensity of traffic represents interaction between vehicles, drivers, pedestrians, cyclists and other participants and infrastructure including roads, signs and devices for traffic control (Caragliu, Del Bo and Nijkamp, 2009). Purpose of measurement of traffic flow is understanding and development of optimal traffic flow with minimal congestions. For traffic flow measurement as a main information is used average annual daily traffic (AADT) and it is obtained by total number of vehicles for a year on a specific section divided by number of days in a year (Galán-García, Aguilera-Venegas and Rodríguez-Cielos, 2014).

Basic parameters of traffic flow are (Lécué *et al.,* 2014):

- Vehicle flow. Flow is the rate at which vehicles pass a given point on the roadway, and is normally given in terms of vehicles per hour.
- Density of traffic flow. Density refers to the number of vehicles present on a given length of roadway. It is reported in terms of vehicles per mile or vehicles per kilometre.
- Speed of traffic flow. The speed of a vehicle is defined as the distance it travels per unit of time.
- Peak Hour Factor (PHF). The ratio of the hourly flow rate (q60) divided by the peak 15 minute rate of flow expressed as an hourly flow (q15). PHF= q60/ q15.
- Vehicle volume. Volume is simply the number of vehicles that pass a given point on the roadway in a specified period of time.
- Time interval between vehicles. Gap is very similar to headway, except that it is a measure of the time that elapses between the departure of the first vehicle and the arrival of the second at the designated test point.
- Distance between vehicles (Clearance). Clearance is similar to spacing, except that the clearance is the distance between the rear bumper of the leading vehicle and the front bumper of the following vehicle.
- Total distance (Spacing). Spacing is the physical distance, usually reported in feet or meters, between the front bumper of the leading vehicle and the front bumper of the following vehicle.

There are two types of counting traffic flow and they are static and dynamic. Static – vehicles which pass in certain period of time through the certain section of the road are counted. Dynamic – it is counting of traffic flows. Actually it is used to determine intensity, direction and path of traffic flows.

Not only that information are collected from the traffic, one of the great ways to stop traffic jams is improvement of parking systems. It is considered that 30% of city traffic jams are caused by drivers who are looking for a parking spot. In a study 15 city blocks are observed in Los Angeles for a time duration of a year. Researchers have found out that drivers have driven more than 1.500.000 km, produced 730 tons of carbon dioxide and used around 200.000 l of fuel to find a parking spot. Smart parking has a job to find quickly and efficiently parking spot for each user. Some of analysed examples allow users to reserve parking spots directly from mobile application (Wang and Wenbo, 2011).

Smart wireless sensors build in the parking spots can collect data in real time about certain parking spot. Sensors will follow if the parking spot is occupied, empty or expired. Device sends information to competent centre which is connected with mobile application for drivers. Using the application user can find a free parking spot, and the city can thoroughly change traffic patterns and driver's habits.

3. MODEL OF MEASURING TRAFFIC BASED ON IOT

In this work is shown model of measuring traffic flow based on IoT. System allows monitoring of number of vehicles which in certain point of time drive through certain section of the street. Basic component of the system is laser for distance detection. On the basis of work of laser it can be measured how many vehicles have passed. In case of cutting the laser beam, the noise level will be checked with the sound sensor LM393 and it will be determined if the car has passed or some other object. In addition to laser and sound sensor, Raspberry Pi microcomputer and Arduino microcontroller will be used.

In case number of detected vehicles passes the certain point, it is possible to conclude that on a monitored road traffic jam has developed. Another parameter to detect traffic jam is constant cutting of laser beam. In these situations, vehicles are moving slowly which leads to long-term cutting of laser beam.

Using this kind of model it is very easy to determine critical spots of traffic jams in the city. This information is of a great importance for drivers and authorized personnel. It is possible to inform drivers about traffic jams and offer them an alternative route, and authorized personnel can analyse traffic and implement changes that will decrease traffic jams.

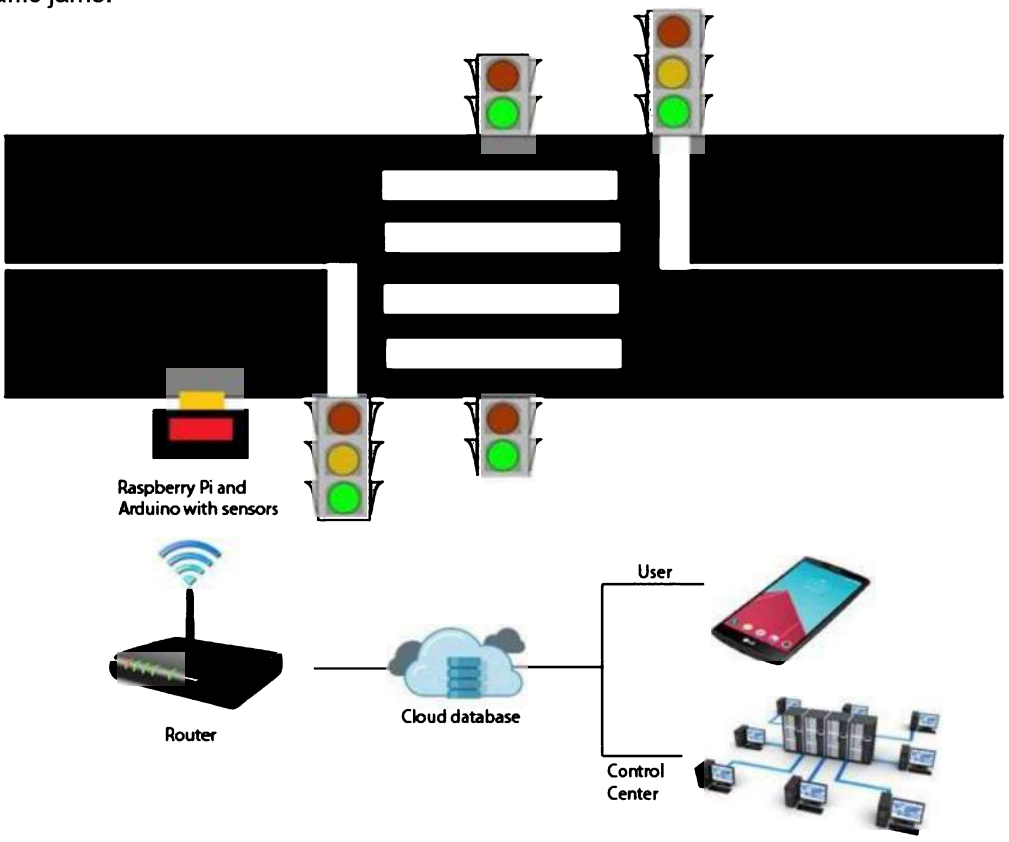


Figure 1: Model of measuring traffic flow based on IoT

Sensibility of the sound sensor is set to minimal, so it would avoid detecting any other sounds other than the sound of vehicles. The device follows the sound and registers the number of vehicles that passed. Remote following of the counter is also possible through web application.

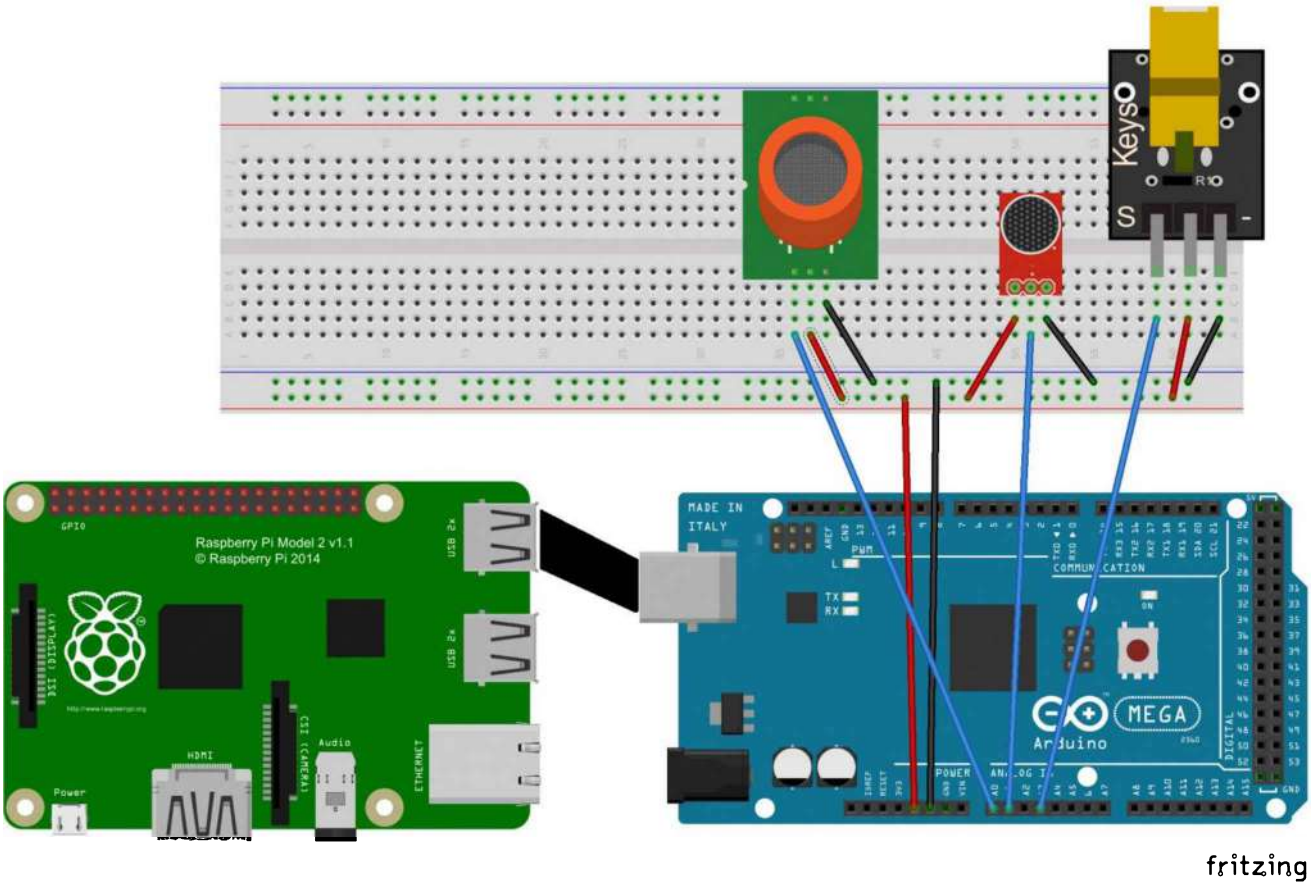


Figure 2: Physical connection of devices

On the picture are shown Raspberry Pi microcomputer and Arduino microcontroller connected with sensors and actuators. Black lines represent cables that are connected to the ground (negative pole) on Raspberry Pi. Red lines represent cables that are connected to power source of 3.3v or 5v on Raspberry Pi. Blue lines represent cables that transfer data between devices.

Raspberry Pi has a web server running. Arduino is connected to Raspberry Pi and sends data read from sensors. Laser sensor, sound sensor, CO2 air pollution sensor are connected to Arduino. Raspberry Pi is running on Linux distribution called “Raspbian”. Web server is developed using “web.py” framework and has a task to send information to service that saves them in database. Because of big amount of data the non-relational database is used (MongoDB) and it is located on the cloud.

4. DEVELOPMENT OF WEB APPLICATION FOR TRAFFIC FLOW MEASUREMENT

This paper shows a web application that allows monitoring the number of vehicles in real time. Based on collected data it’s needed to do analysis and represent results to user in graphical view. The web application is developed by using Bootstrap framework. For graphical view of data is used Chart.js library. Application logic on server side is developed in PHP programming language. Parts of the application logic that are being executed on client’s side are developed using JavaScript. For data insight in real time is used AJAX. All communication with web server takes place through sending and receiving HTTP requests that carry data in JSON format.

Alongside with the insight of traffic flow in real time, it is also possible to filter the data and get more information for previous period of time. Actually it is possible to choose previous day, week, month, year or any other time period. This information can help people who are responsible for highways to make some revolutional changes and make much better traffic system. Also, it is possible to get information about air pollution for certain sections of the road.

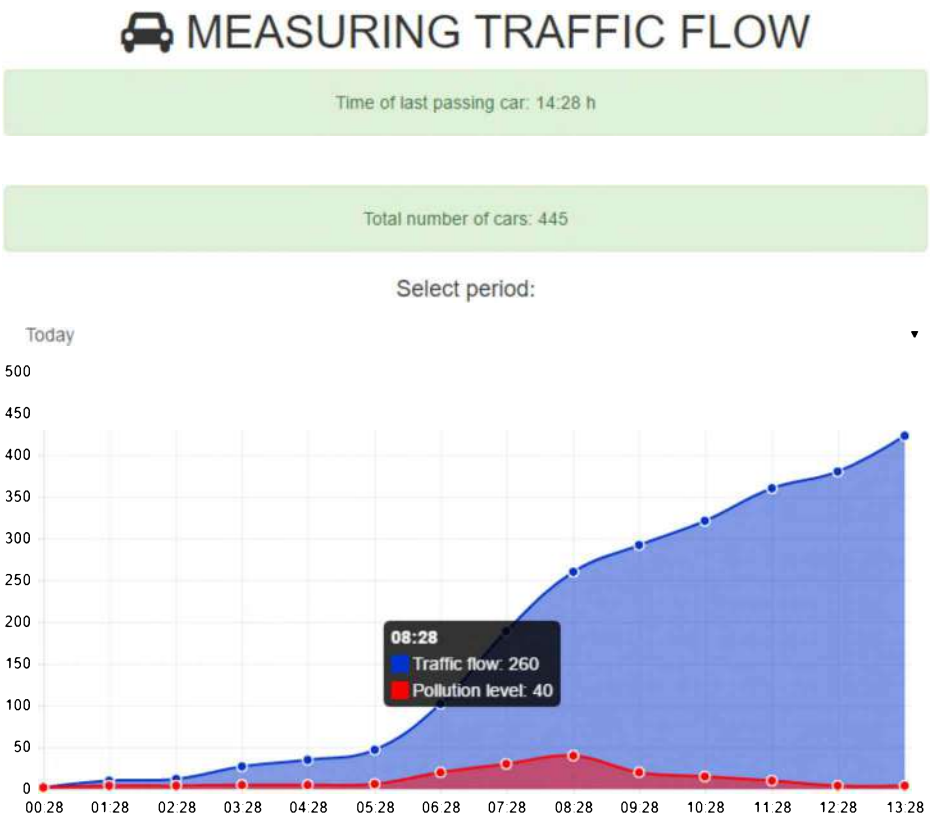


Figure 3: Web application

As an alternative to web application it is possible to develop mobile application. Within mobile application user would have an insight to the same data like in a web application, with some additional functions like push notifications. System would follow current location of the user and in case of noticing that user is moving through route where is traffic jam it would pop up notification with a new route. During suggestion of a new route it should do the selection of users so it doesn't happen that all users get rerouted to the same route. In case of traffic accident in certain street, operator can easily send notification to all users. It is also possible to develop system that will send SMS messages. User can send a message to the certain phone number to get some information about traffic flow and as a replay he/she will get list of the streets where is traffic jam.

Figure 4: Proposal of system with push notifications

5. CONCLUSION

In this work is shown model of measuring traffic flow based on IoT which was developed on Department of e-business at Faculty of Organizational Sciences, University of Belgrade. Architecture of the proposed model is defined. Furthermore, implementation for model for traffic flow measurement and level of air pollution on the roads was shown.

Main advantages of this solution are simplicity, low cost of equipment and possibility of implementation in other smart environments like smart parking. Important advantage of this solution compared to other solutions is collecting information in real time which offers possibilities with smart traffic signs, traffic can be rerouted to less crowded roads and avoid congestions in this way. Model can be improved with additional sensors. Expanding the sensor network will increase data collection which will lead to improvement of system precision and it will allow recognition of driving patterns.

While other solutions relay on data from cameras (Calderoni, Maio and Rovis, 2014) and information from mobile phones (Khoo and Asitha, 2016), this solution is completely relayed to sensor information which is it's advantage. Cameras are more expensive, it is harder to estimate number of vehicles, and applications can undermine user's privacy.

Real-time and historical data collected from network of sensors are used for prediction of travel times. Travel times are usually posted on the web and on signs both on the side of highway and on overhead signs (Bickel, 2007).

All analysed systems are facing the same problem – rejecting users to use alternative routes (Khoo and Ong, 2011). In Malaysia the survey was conducted about using applications to avoid traffic jams. Only 26% of drivers was ready to change their route and use the one that application has suggested. This number is not big enough to make significant difference. Although this percent will grow, it is needed to increase conscience of the drivers about those applications and their advantages.

Today`s main focus is on technologies that are measuring traffic flow of vehicles, but in the future we might see new hybrid systems that are using similar technology to measure flow of pedestrians along sidewalks as well for counting bicycles on the roads.

REFERENCES

Batty, M., Axhausen, K., Fosca, G., Pozdnoukhov, A., Bazzani, A., Wachowicz, M. & Portugali, Y. (2012). Smart Cities of the Future, UCL Working Papers Series, vol 188.

Bickel, P., Chen, C., Kwon, J., Rice, J., van Zwet, E. & Varaiya, P. (2007). Measuring Traffic , Statistical Science, vol. 22, No. 4, 581-597.

Calderoni, L., Maio, D. & Rovis, S. (2014). Deploying a network of smart cameras for traffic monitoring on a "city kernel', Expert Systems with Applications, vol. 41, no. 2, 502–507.

Caragliu, A., Bo, C. Del & Nijkamp, P. (2009). Smart Cities in Europe, 3rd Central European Conference in Regional Science – CERS vol. 3, 45-59.

Galán-García, J. L., Aguilera-Venegas, G. & Rodríguez-Cielos, P. (2014). An accelerated-time simulation for traffic flow in a smart city, J. Computational Applied Mathematics, vol. 270, 557-563.

IBM, The Internet of Things: An Iconic Example of a Smarter Planet. Available from: http://www-01.ibm.com/software/info/internet-of-things/ [16.04.2016.]

Khoo, H. L. & Asitha, K.S. (2016). User requirements and route choice response to smart phone traffic applications, Travel Behaviour and Society 3, 59-70.

Khoo, H.L. & Ong, G.P. (2011). Analysis of awareness and utilization of traffic information system using revealed preference data: A case study of Klang Valley, Malaysia, Transportation Research Record, Transportation Research Board, Vol. 2239, 101-111.

Lécué, F., Tallevi-Diotallevi, S., Hayes, J., Tucker, R., Bicer, V., Sbodio, M. & Tommasi, P. (2014). An accelerated-time simulation for traffic flow in a smart city, Procedia Computer Science vol. 00, pp 1-10.

SAS (System Analytical Systems), What is Internet of Things (IoT). Available from: http://www.sas.com/en_us/insights/big-data/internet-of-things.html [16.04.2016.]

Wang, H. & He W. (2011). A Reservation-based Smart Parking System, IEEE The First International Workshop on Cyber-Physical Networking Systems, 701-706.

INTELLIGENT PARKING SERVICE MODEL

Predrag Vuletic*[1], Zivko Bojovic[2]
*Corresponding author, e-mail: pedjanalog@gmail.com

Abstract: *The intelligent parking service model is a part of broader smart city project which was created with the aim to enable more efficient regulation of traffic in cities with reduction of harmful gases emissions and to increase the parking service profit. It is based on drafting of updated database on available parking space, definition of vision and goals of a new parking system, and on creation of conceptual framework for implementation of the intelligent parking system project (marketing, market analysis, improvement of cooperation with clients and extended business). Our forecast is that implementation of smart parking systems and application of Canvas business model with Testbed IoT, assuming reduction of labour force through automation of the majority of business processes, will increase revenues by 20%, while decreasing traffic congestion by 30%.*

Keywords*: IPS, wireless networks, business model, Testbed IoT*

1. INTRODUCTION

The goal of implementation of intelligent parking service in urban areas is related to implementation of plans pertaining to functioning of parking system within a positive balance, reduction of traffic congestion, noise and harmful gases emissions in traffic. Implementation of this idea is a challenge in terms of achievement of ideal balance between mobility, safety and environmental protection requirements. Regardless of greater automation of business environment, implementation of intelligent solutions in traffic, based on IoT technologies, requires the establishment of smart innovative management. The management will face a serious challenge how to solve a problem of inefficient parking space management and reduce traffic density on urban roads in the situation of constant growth in number of residents in urban areas with expressed tendency of further growth. Implementation and flexibility of parking space management model is the main motive which is the basis for business strategy of the parking service management. Implementation of intelligent parking service (IPS) could enable implementation of the following goals:

- Integration of available parking space into a unique parking space base which would be at public parking service disposal. This implies that in addition to state-owned parking space, the aforementioned parking space base would include parking lots owned by physical and legal entities, with definition of contractual obligations between parking space owners and public parking service.
- Implementation of reservation service in parking system which means that user can e-mail, text or call (voice identification) to require reservation of parking space at certain location. The user gets a possibility to define duration of reservation and payment option, applying the system *pay per use* (difference compared to the so far way of calculation based on initiation parking hour).
- Generation of offer of free parking spaces thus providing the clients with possibility of parking lot choice. Clients are offered several free places located in different distances from the required destination. Depending on the distance, the client is also presented a financial offer for each proposed parking place.
- Introduction of parking space classes, economic and business ones, in wider fenced parking lots and garages. Economic class would have more parking places, while business one would have fewer places, which would be wider and longer, with longer period of time available for parking, and would be closer to the exit.
- Central monitoring and configuration of devices from remote location, thus reducing need for hiring of controllers for supervision and enforcement of penalties on parking space.
- Introduction of discounts for certain free places, as well as different advertisements. This would enable direct inflow of funds through stimulation of users.
- Additional introduction of security systems, i.e. protection of information.
- Stimulation of use of electric cars through application of lower parking rates and electricity costs, with subscription on longer period for this type of vehicles.
- Charging of fees while passing, i.e. at the entrance and exit of vehicle to and from the parking lot by introducing RFID readers.
- Introduction of business promotions for other companies, as well as dual market actions.

- Introduction of voice navigation to a parking place, as well as video imaging of free parking places, with possibility to choose zones and places.
- Introduction of day-night charging system, which would offer to clients such parking spaces free during the day but occupied during the night and vice versa.
- Reduction of fuel consumption by implementing a system which enables shorter parking. This would influence reduction of pollution, thus leading to environmental sustainable development.
- Implementation of updated database which in case of disputes provides parking service a possibility to protect business interests of public parking service business based on exact data.
- Networking with police communication systems, which would enable automatic check of vehicle registration.

2. SYNTHETIC INTELLIGENT PARKING SERVICE MARKET

Dynamics of users' requirements and need to find fast and efficient solutions for them, as well as need for more efficient business are the main driving forces for market change. This is why advanced information-communication technologies are ever more frequently applied in different areas of economy, such as transport, energy, industry, trade, etc. Application of these technologies significantly alters processes and entire market, approximating them to achievement of the vision of smart market. Smart markets (SM) are a form of synthetic intelligence which requires a wide array of researches in the area of theoretic formulation and optimization of technical resources, including development of researches about individual users' behaviour and characteristics of market mechanisms. Dynamics and scope of changes in a society caused by the development of new technologies such as IoT impose the need for application of advanced solutions which would provide for high degree of intelligence in real time (Bichler, Gupta, & Ketter, 2010). In this paper, we have addressed the development of intelligent parking system (IPS) model, which would be based on advanced parking space management system in urban areas, i.e. establishment of smart parking space market. This market should function on the following principles:

- centralised disposal of available parking space in urban areas (regardless of the ownership)
- implementation of IoT application and continual updating of data about the availability of parking spaces
- definition of a dynamic pricing set based on readiness of clients to pay for example in auctions for lease of parking space on shorter or longer time period

The need for information exchange between users searching for free parking space and accuracy thereof are of crucial importance for the development of IPS. Traffic generated by vehicles searching for free parking space is a problem in urban areas from the aspect of traffic, but also from the aspect of environmental protection. The existing research indicates that circulation of vehicles increases concentration thereof on roads, especially in central urban zones, where there is a huge demand from drivers (multiple-car-chasing-singlespace phenomenon) (Wang & He, 2011). The need of drivers for recommendations, i.e. for the assistance in finding free parking space, influences expansion of service mobility and improvement of navigation service. Intelligent parking system should be designed according to method of "clients' attraction on the fly". The existing solutions in the area of parking service indicate that providers of this service paid small attention to drivers' needs, their wishes and frustrations. New parking system model should be designed to take care of drivers in order to develop trust in IPS model among them, thus making them ready to pay more for the service. Strategic investments into the technology and marketing of IPS, in accordance with continual development of urban development solutions within the smart city project are prerequisites for sustainability of the smart parking space market project. Functioning of IPS is heavily influenced by reliable system operation, since interruption in communication links would mean loss of revenues and significant influence on operator's reputation. The IPS model can be complex depending on facility type, but electronic payment must be continual and uninterrupted, with minimization of disputable transactions, misuse of credit cards and theft of sensitive information (Bayless & Neelakantan, 2012). The IPS model is based on offer to a new service to drivers, with a possibility of free parking place reservation. The service is implemented in such a manner to have three levels of autonomous functions: coordination level, local parking management level and parking spot level (Babic, Carvalho, Ketter, & Podobnik, 2015). The coordination level should be based on different monitoring sub-systems (Illustration 1), which would collect data from sensors about availability of parking places based on the principle "available-unavailable". Data is analysed in further steps, together with information about the vehicle having sent a request for parking space reservation. The IPS model is designed in such manner to provide drivers with possibilities to pay by card, text message, by invoicing etc. New dimension to IPS quality is provided by possibility to navigate, i.e. a driver can, upon the accomplished reservation of parking place, receive a preferable route through an application on their mobile device, with voice navigation, as well as with image of the parking place from the camera. Smart parking spare market implies a possibility to apply auctions in the stage of parking space reservation. Namely, distance of the parking place from the driver's destination location significantly impacts the driver's motivation to pay certain price for the parking place lease. The time needed to get to the parking place is 10 minutes maximally.

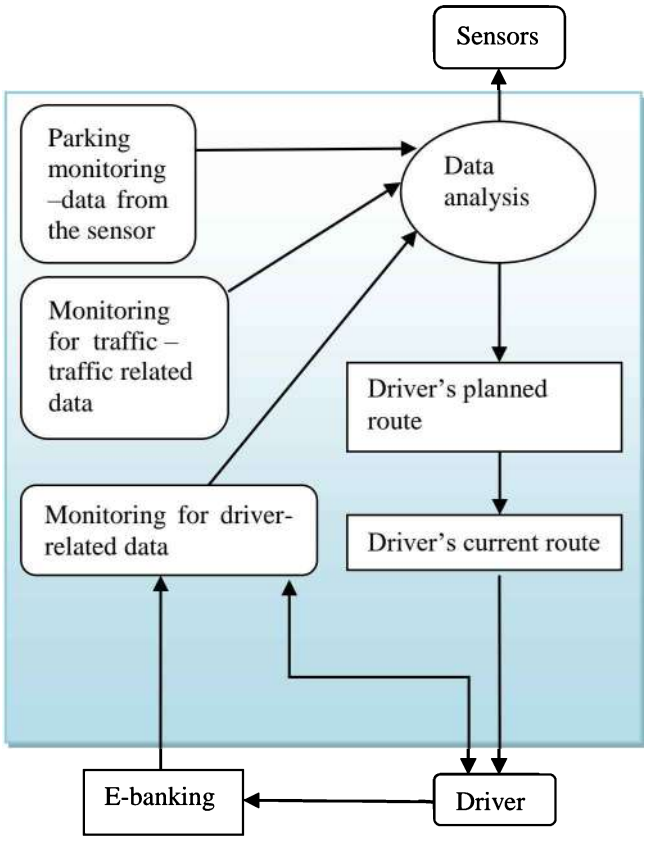


Figure 1: Schematic diagram of the proposed IPS monitoring system

If the driver does not follow the route recommended by the navigation, after the expiry of that period, the driver can request additionally free parking place because they are not entitled anymore to the previous one. The driver is directed to next free place with certain fee charged for the service. In the event that they do not reach that parking place on time, the driver loses the right to request additional parking place in the next two hours, and is not entitled to refunds. Parking time starts from the moment when driver parks their car and confirms the arrival through the application. Special position in our IPS model is given to a system for the protection of reserved parking places. This system implies "lighted" marking of parking place by emitting red light beam from the sensor in cases when other drivers searching for the parking place try to park their car there. In addition to the mentioned solutions, the proposed IPS model implies application of new charging policy which would additionally influence reduction of harmful gases emissions. Our IPS model anticipates stimulation of use of electric cars in order to reduce CO_2 emissions. In order to create technical conditions for the application of this type of stimulation, the parking lots would be equipped with smart battery electricity chargers. The complexity and dynamics of the environment is potential obstacle for the business perspective of this solution. The reason for that is actually the fact that parking transformation process implies the complexity of profit estimation of the smart parking owner and length of time required for the initial investment return (Iordache, Nemtanu, & Cormos, 2015). Electricity market, as a component of this system, would be considerably integrated with its solutions for smart market.

3. INTELLIGENT PARKING SERVICE BUSINESS MODEL

Business model in a usual word in the world of management, but over the past several years it has been attracting great interest for researchers (Morris, Schindehutte, Richardson, & Allen, 2006). Parking service is a system whose functioning is based on linkages of numerous information system segments. This includes data collection, selection, controlling, transferring, processing, distribution and protection. Marketing plan must be open and transparent with the following key and interest approach:

- Basic information about the company, company business philosophy, marketing definition of the company business, company vision and mission, SWAT analysis, business history.
- Analysis of introduction of business automation through wireless network and sensor communication.
- Reduction of costs, increase of revenues, safety in traffic, environmental protection.
- Creativity, use of Serbian and English language in user applications, marketing tactics through use of social networks and Google services.

- Development of new parking system would be designed in phases throughout a certain period of time.
- Graphic layout of cost-effectiveness threshold.
- Defining the needs of the existing and potential users.

The proposed platform, i.e. the model, would increase net profit, at the same time possibility to buy new plots of land for the construction of vertical garages, possibility of business outsourcing and improvement of advertising. The structure of revenues collected from parking subscription fees, sold electronic tickets, additional tickets and from sponsorships and cooperants would greatly influence development of a financial plan in the own funds segment. Nevertheless, credit lines should be involved in addition to own funds, because of the amount of initial investments and relatively fast return of the invested capital. The structure of estimated investment value includes: fixed and current assets. Fixed assets include financial costs for the product development (hardware and software), labour for the product development, market analysis, e-commerce and miscellaneous segment. The costs for labour invested in the product development include: concept and development thereof, documentation, programming, testing, prototype, customer support service, e-mail marketing, website, e-commerce solutions, web marketing, providers' services, advertisements and promotions. In addition to these costs, there are also fixed costs, such as costs for electricity bills, Infostan technologies – utility services, construction land, internet, telephone, stationery, fuel, etc. Operational monthly costs include administrative costs, sales and marketing costs. When it comes to depreciation, it has to be carefully considered, since usage period for sophisticated technology is short, and IPS development stage would take three to five years period. Data about labour force is very important, and implementation of IPS would surely affect the reduction. In order to maintain a "healthy" company while introducing new technologies and IPS model, cash flow should always have positive tendency and scale in balance sheets should always be rising. The value of the proposed is ranked according to consumers, in other words, if customers' needs are met, the value of the proposed system is greater. This means that the first basis should be found in the development part of *Testbed IoT*, incubating the IoT success, which could be subsidised as a part of the financial plan. The second level is implementation in the field, i.e. placement of the results obtained in the first stage through observations and responds obtained from end users. Testbed provides for reasoned guidelines for strategic decisions and investment plans, and it also selects strategic and non-strategic partners. Such logistics pertains to the example of the provision of equipment for Testbed, as well as to indirect call for companies which would develop and test their applications, hardware and communication protocols in real living environment. The interaction in creation of brand must be instrumental to consumers with innovations and support network. What s the most interesting for Testbed stage is double influence on revenues, influence to the IPS preliminary design and impact to attracting of other IT companies which would rent space to research their experimental-oriented services. Traditional business models are designed in such way to focus exclusively on the basic company. However, because of new technological dynamic development environment, companies must quickly adapt to market challenges. As a result of that, innovation business models are becoming a new, additional link or "new routes towards the competitive advantage" (Sun, Yan, Lu, Bie, & Thomas, 2012). With IoT *Get-ahead* and *Catch-up* strategies, companies primarily enable themselves to have the forecast time period. Namely, the get-ahead strategy is a set of actions and plans which enable achievement of a position above the competition, while catch-up strategy is a set of actions and plans which enable monitoring and learning from leaders through operational efficiency and quality. Taking the aforementioned into account, Table 1 demonstrates the process of structuring and evaluating of the IPS business plan, which is composed of four sets: infrastructure, proposed values, clients and finances. Infrastructure is divided into three topics: key partners, activities and resources. In addition, the main topic of customers is also divided into three sub-topics: customer relations, clients and client groups, and approaches to clients. Financial area is divided to the structure of costs and revenues. The identified topics are not autonomous, but are inter-conditioned. Key partners are associated with the common goal, and this is creation of alliance for the improvement of the business model, reduction of costs, risks and uncertainties, with the support of specific resources and activities. Key activities define what the partners are supposed to do and how to do that, e.g. consultancy offer, software development, etc. since every business model must have some sort of resources to create value towards the clients, key resources in this case would be means for maintenance and support of business. Resource type can be intellectual, financial, human or physical, and they should be provided by key partners, based either on ownership or outsourcing from another company. The value proposition will form innovation as new or similar solution for a certain product or service for the area of customers. Wise selection of clients by the company, as well as listening to their needs through adequate access channels generated mutual trust and accomplishment of the expected goals on both sides.

According to data of the Republic statistical office, the number of passenger vehicles in the Republic of Serbia has been increasing constantly over the past several years. For example, the number of passenger vehicles registered for the first time in 2015 was higher by 6.9% than in the year before, while mopeds and motorcycles record certain fall (Republic Statistical Office, 2016). This indicates that need for more parking places, using IoT solutions, is one of primary goals of city administrations.

Table 1: Business IPS Canvas model with Testbed IoT

<table>
<tr>
<td rowspan="2">KEY PARTNERS

➢ Institutions dealing with public transport
➢ City transport
➢ Authorised car representatives
➢ Authorised car mechanic services
➢ Auto-motorcycle sport media and organisations
➢ Social networks</td>
<td>KEY ACTIVITIES

➢ Networking with clients
➢ Networking with partners
➢ Coordination
➢ Development and research</td>
<td rowspan="2">INTELLIGENT PARKING SERVICE

➢ Integration of all parking places in the city (state- and privately-owned)
➢ Testbed IoT
➢ Introduction of sensor communication through a wireless network
➢ Remote control with control of parking place
➢ Introduction of pay per use
➢ Introduction of fitting systems for electric vehicles
➢ Gradual phase-out of controllers and paper tickets, i.e. daily tickets
➢ Rationalisation in human resources and expenditure
➢ Construction of vertical garages
➢ Better organisation of traffic
➢ Reduction of traffic congestion and of harmful gases emissions
➢ Greater interactivity with clients and adaptation to their needs
➢ Networking with the police
➢ Outsourcing business</td>
<td>CLIENT RELATIONS

➢ Assisting to clients in purchase of electronic tickets
➢ Automation of services
➢ Specific client relations for clients who often use IPS services, as well as with members
➢ Development of relations with other companies and their staff</td>
<td rowspan="2">CLIENTS AND CLIENT GROUPS

➢ Younger drivers
➢ Elder drivers
➢ Car drivers
➢ Moped and motorcycle riders
➢ Families
➢ Clients with special needs
➢ Employees of specific companies</td>
</tr>
<tr>
<td>KEY RESOURCES

➢ Information and knowledge
➢ Space for the monitoring centre
➢ Hardware and software architecture
➢ Patents and ownerhip rights of the Smart Parking Service
➢ Human and financial resources</td>
<td>CLIENT ACCESS CHANNELS

➢ Internet
➢ Mobile phones
➢ Printed advertising material
➢ Media</td>
</tr>
<tr>
<td colspan="3">COSTS STRUCTURE

Reduction of costs through automation
➢ Procurement and maintenance costs
➢ Activity costs
➢ Partnership costs
➢ Costs for the development of client relations</td>
<td colspan="3">REVENUES

➢ Website with electronic purchase model, purchase of products, services and contents
➢ Web business – advertising space would be ceded to other companies charging a proper fee for that, i.e. sale of advertising banner space
➢ Subscription model for access to certain facilities or services – e.g. motor racing, Nascar racing, etc. Subscription would be on monthly, semi-annual and annual levels
➢ Transaction sale could be applied in e.g. auction sale of spare parts and service offer, thus bringing commission to the parking service from salesmen who would gain revenues from the sale
➢ Sales model would be implemented through ticket, information and service sales
➢ Affiliation model would be implemented by referring the buyers to other companies who would buy products and get certain discount on them, and parking service would gain commissions for such referrals once the sale is finished</td>
</tr>
</table>

4. CONCLUSION

Application of advanced solutions leads to the improvement of the existing and introduction of new services for more efficient fulfilment of users' needs. One of these services includes possibility to reserve parking places at any time, from any location, and in any way. Implementation of this service would enable the users to plan and implement their activities more efficiently, but also to reduce fuel costs. From the aspect of city authorities, this model is an efficient solution for the reduction of congestions on urban roads and harmful gases emissions. However, implementation of IPS is complicated by the following: impossibility to complete the database due to the lack of regulatory provisions pertaining to which entity offers parking space (whether it is only the Parking Service or specific private and business owners), as well as regulation of mutual obligations. Would it be better to develop a separate system or an integrated platform, or to go through a network of telecom operators? Separate system based on cloud and SDN solutions is a better and long-term option, because it eliminates the dependence on telecom operators. The question is whether telecom operators would let that happen. How to make a good business plan to justify the investment if you cannot see the relation thereof to the operators? Is there legislation that would allow the use of stock exchange for the lease of parking spaces at busy locations? The need for qualified staff, in addition to all of these issues, is a bottleneck at the moment, but it is also a good starting point for modern traffic.

REFERENCES

Babic, J., Carvalho, A., Ketter, W., & Podobnik, V. (2015). Economic Benefits of Smart Parking Lots. Erasmus Energy Forum 2015 Science Day.

Bayless, S., H., & Neelakantan, R. (2012). Smart Parking and the Connected Consumer. The Intelligent Transportation Society of America (ITS America).

Bichler, M., Gupta, A., & Ketter, W. (2010). Designing Smart Markets. Information Systems Research Vol. 21, No. 4, 688–699.

Iordache, V., Nemtanu, F., C., & Cormos, A., C. (2015). Autonomic integrated parking system for smart cities. ARTS ECR 2015.

Morris, M., Schindehutte, M., Richardson, J. & Allen, J. (2006). Is the Business Model a Useful Strategic Concept? Conceptual, Theoretical, and Empirical Insights. Journal of Small Business Strategy, 17, 27-50.

Republic Statistical Office (2016). Registered road motor and trailer vehicles and traffic accidents on roads, 2015. No. 061 – year LXVI, 11.03.2016.

Sun, Y., Yan, H., Lu, C., Bie, R. & Thomas, P. (2012). A Holistic Approach to Visualizing Business Models for the Internet of Things. Communications in Mobile Computing, 1, 1-7.

Wang, H., & He, W. (2011). A Reservation-based Smart Parking System. The First International Workshop on Cyber-Physical Networking Systems, 684-689.

AN APPLICATION OF TEXT TO SPEECH IN SMART HOME

*Đorđe Knežević, Pavle Lošić, Živko Bojović
Faculty of Organizational Sciences, University of Belgrade
*Corresponding author, e-mail: djordje@elab.rs

Abstract: *This paper shows an example of implementation of Internet of Things in smart house. The model for managing the smart house through voice commands is developed as purpose of increasing pleasure of those living inside the smart house and making the everyday situations easier. This paper shows an example of implementation of lightning, alarm system, fire extinguishing system as well as system for increasing environmental awareness. All these systems can be managed through voice commands or through a web* application.

Keywords: *smart house, IoT platform, TextToSpeech application, augmented reality*

1. INTRODUCTION

With everyday technology progress, first of all increasing processor's power and decreasing their size, totally new generation of computers has emerged – microcomputers. These devices have enabled us to create smart environments. The concept of smart environments represents "physical world that is richly and invisibly interwoven with sensors, actuators, displays" (Weiser, Gold and Brown, 1999.). Main purpose of smart environments is increasing user's pleasure (Cook and Das, 2005). Concept of smart environments is achieved by using Internet of Things.

Internet of Things (IoT) is a network of smart objects connected to the Internet which can communicate with each other (Tan and Wang, 2010.). As the number of smart devices connected to the Internet is exponentially rising, so is rising our ability to send, receive, collect and analyze data from any device at any moment (Hanne, Ovidiu, Tracey and Roy, 2012).

One of the elements of smart environment is a smart house. Smart house enables us to simultaneously manage large numbers of devices using lots of different services and applications. Definition of smart house is changing with the development of new technologies. Previously, it has been thought that the smart house is the one that has devices which are connected to the Internet and which we can access using the Internet. However, today smart house is the one in which devices are not only connected to the Internet, but they can also communicate between each other (Wu *et al.*, 2010).

This paper shows a development of a system for managing the smart house through the voice commands. Web platform and mobile application are developed so the voice commands could be given to the system. Apart from the display of read values and actuator states on both applications, users will be provided with additional functionalities within the mobile application, like sending an e-mail or SMS messages. The main purpose of web platform is to assist the administrator in defining the environment, sensors and actuators. Web platform will provide a secondary way for managing the system.

2. LITERATURE OVERVIEW

A smart house is the house that includes advanced automatization of the system with the purpose of enabling more sophisticated surveillance and control over the functions inside the smart house. For example, in smart houses lightning, temperature, multimedia and security systems can be easily controlled. Users can not only manage these devices but they can also get feedback from the house with

their state and history. Smart house can be managed in many ways, the most common ways are: Web application, mobile application, SMS message, remote controller and voice commands.

One of the interesting ways of managing the smart house is using voice commands. Not only that it is very interesting and intuitive, but it enables it's user to simultaneously do more than one thing. For example, user can, while leaving the house, simultaneously activate the alarm, shut down the lights and get dressed. Feedback is provided through sound which enables user to stay focused on the thing that he is doing at the moment.

Automatic voice recognition is a process in which the computer is processing human voice and creating a textual representation of spoken words. Control over the voice commands is getting more and more popular with it being used not only in smart houses, but also in smart phones, smart cars, smart tablets and smart TVs.

After analysis of the literature, it can be concluded that the smart houses are different depending on technical equipment and technologies that they are using. Wireless technology, mobile applications, multimedia control and fast Internet access are usually used. Some papers highlight the importance of the smart medicine and e-health in smart houses. The focus of these works is facilitating life of the people who live in the house, increasing their security, information availability and managing the devices even though the user is at the remote location.

Some solutions are focused on decreasing the costs through user detection (Makonin, Bartram and Popowich, 2013). It is necessary to detect when users are not at home, so the smart house could adjust the environment, to be more precise decrease the temperature and shut down the lights. Result can be improved if the system knows when the user needs to come back home, that way more energy can be preserved. The energy efficiency of the house can be further improved by detecting the user's sleep phase (shutting down all the unnecessary devices).

An important element of the smart houses is health of household members (Juniper research, 2014). Internet of Things provides data about user on the level that was just not imaginable until now. Implementing different medical devices, it is possible to greatly increase the life quality of people with physical disability and it is also possible to detect symptoms of different diseases even before they occur.

Large number of studies are focused on security of the systems itself. During application development for smart houses it is necessary to pay attention to network security on which devices are connected, data privacy, communication security, identification and authorization of the user and many other parameters (Enisa, 2015)

3. SMART HOUSE SOLUTION DESIGN

In this work is shown development of the model for managing the smart house through voice commands. The model consists of: microcomputer, microcontroller, sensors, actuator which on request of microcomputer and microcontroller change the state inside the smart house. Communication with microcomputer is enabled through web service. The model is shown in Figure 1.

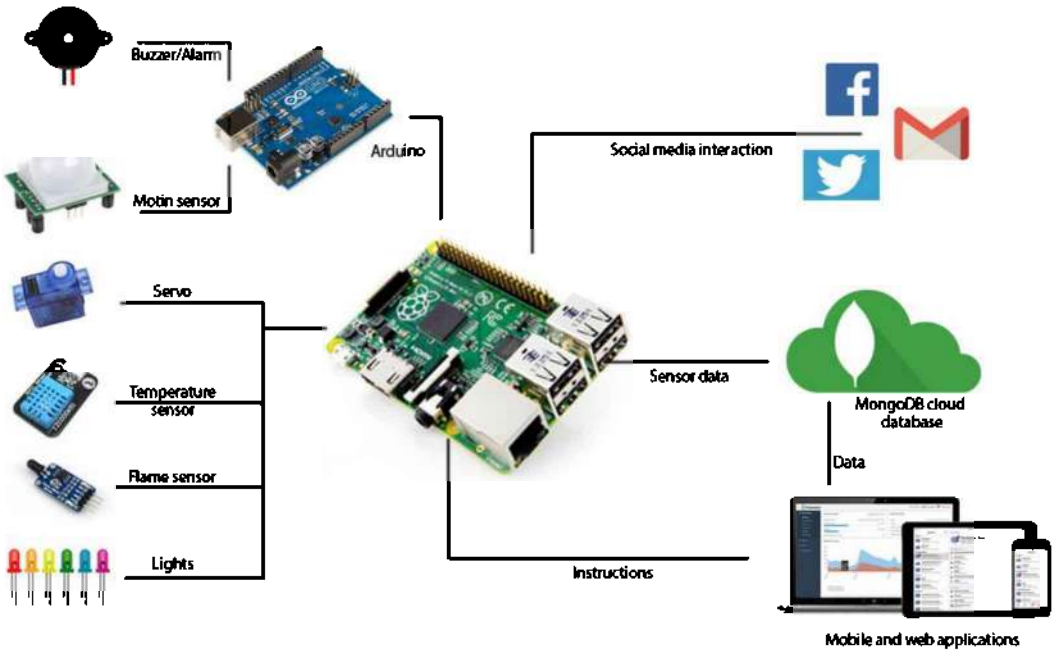


Figure 1: Model for managing the smart house through voice commands

The main purpose of the smart house is to provide to its household members the best and the most secured life style. It's supposed to provide way to managing the lightning, multimedia system, security system, system for maintaining temperature and air moisture inside the house as well as integration with social media.

Centre of the system is Raspberry Pi microcomputer. Temperature, moisture sensors, lightning and flame detector sensors are directly connected to the microcomputer. Except of these sensors, Arduino microcontroller is also connected with the purpose of working on security system. To the Arduino is connected motion sensor which is activated when something is moving. The Raspberry Pi microcomputer runs on Linux distribution called "Raspbian". Web server is located on the device and it is created using "web.py" framework. Because of the huge amount of data, two types of databases are used, relational MySQL database and non-relational MongoDB. In relational database are kept all information for the user and his/hers privileges, sensors and actuators, while in MongoDB database are kept all information from sensors. Within web server is a controller which, based on user's requests, decides which operations will be executed and on adequate way informs user about that. Physical connection of devices is shown in Figure 2.

Figure 2 shows Raspberry Pi microcomputer and Arduino microcontroller connected with sensors and actuators. Black lines represent cables which are connected to the ground (negative) on Raspberry Pi microcomputer. Red lines, in the picture, represent cables which are connected to output of 3.3V or 5V on Raspberry Pi microcomputer. Blue lines represent cables which are used for data transfer between devices.

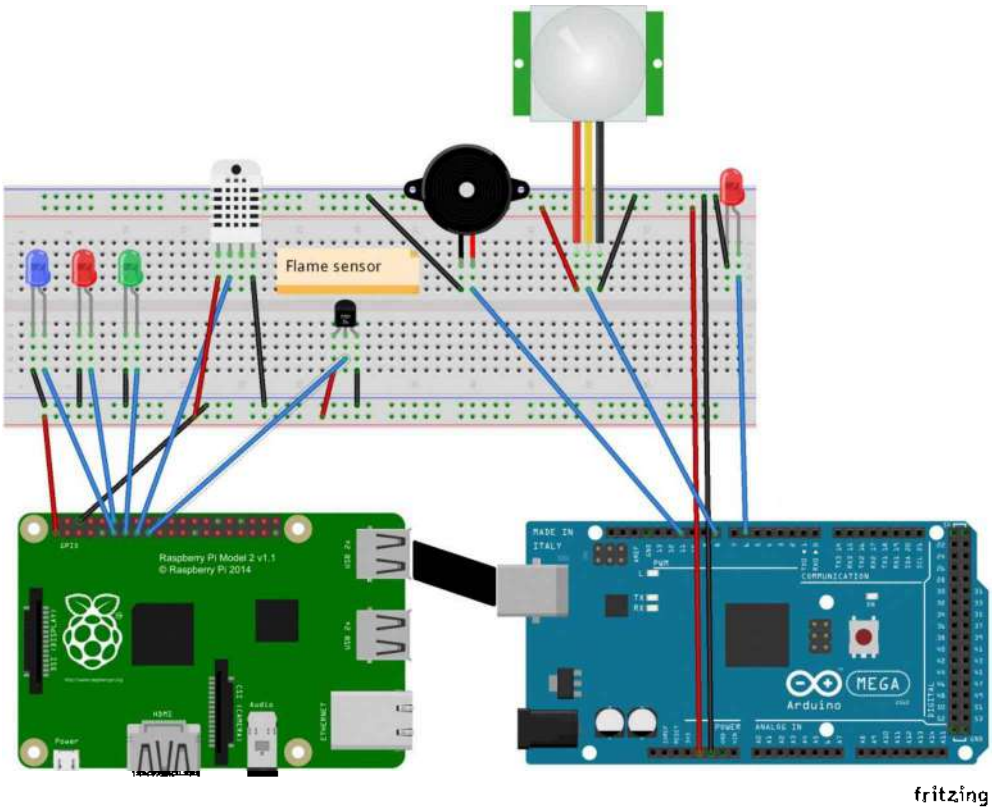


Figure 2: Physical connection of devices

4. DEVELOPMENT OF TEXT TO SPEECH APPLICATION FOR SMART HOME

Project of the smart house consists of 4 main parts. First part is a web server that's set up on Raspberry Pi microcomputer, it is developed in Python programming language. Second part is a web application. Third part is a mobile application for Android OS, which user uses to give the voice commands. Fourth part consists of an application for augmented reality.

Raspberry Pi microcomputer takes the central part in the system. It has the web server which on user's request sends information about current state of sensors. All values read from sensors are kept in non-relational MongoDB database held on cloud (Cyrus and Nayak, 2016). In addition to checking the state, Raspberry Pi manages different actuators like step motor. User with voice commands has availability to check notifications and messages on social media like Facebook, Twitter and Instagram. User can check number of unread messages on its mail account. With the sequence of voice commands it is possible to send an e-mail or SMS message to some of the contacts, as well as get the content of received SMS messages.

Web application consists of two parts: administrative and user part. Administrator can create main account and account for every household member. In addition to creating an account, administrator can change and delete existing accounts, as well as change their level of privileges. The application contains three levels of privileges: parents, kids and guest. User with the privilege parent has an access to every option of the smart house system. User with the privilege kid has an access of insight to a current state of the house and options to manage the systems which parent allows it. Guest privilege is just a temporary privilege which is created by the parent and has limited possibilities. Administrator gives proper sensors and actuators to each client to which he will have insight. Each sensor is given a name and unit of measurement. For actuator, name is defined and set of states which that actuator can have. For sensors

and actuators administrator can define the room which they belong to. Admin panel of the web application is shown in Figure 3.

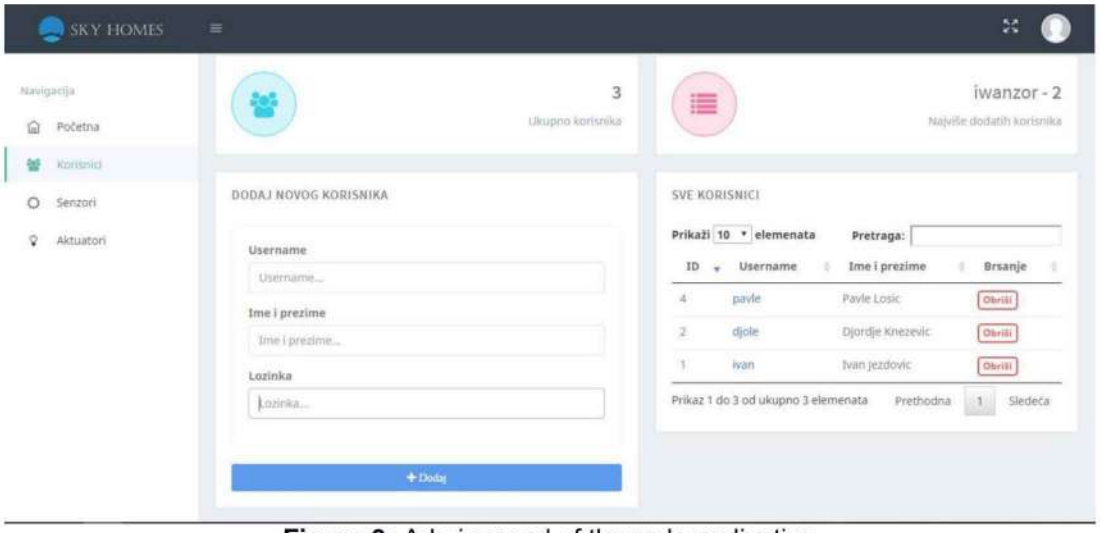


Figure 3: Admin panel of the web application

User is shown the state of sensors in real time in proper part of user interface. Main information are current temperature, air moisture and level of lightning. Also, user is given the possibility of filtering the results as well as graphical view of those data. Depending on the level of privileges, user can manage lightning inside the smart house. Also, on the user panel there is an option for lightning automatization, for example, turning on the lights in previously defined moment of time. User with privilege parent has an option of managing the alarm. On user interface panel there is an option of zoning the house, where it is possible to activate the alarm only in certain rooms.

Web application is developed using Bootstrap framework. Charts.js library is used for graphical interface of data. Logic of the application is set on server side and it's developed in PHP programming language. Parts of application logic which are executed on client's side are developed in JavaScript. For display of actuators in real time is used asynchronous JavaScript (AJAX). All the communication with web server is carried out trough sending and receiving HTTP requests where data is transferred in JSON format. User interface is shown in Figure 4.

Figure 4: User interface

Mobile application is intended for the client and it provides possibility of information review as well as giving the voice commands. For each sensor, user is shown proper information in real time. Same as with the web application, for chosen sensors information can be shown as graphic view for previous period of time. The application provides a way of managing the smart environment with simple speech. These commands are analysed and sent to Raspberry Pi microcomputer which executes them. User has access to these commands: turn on the light, turn off the light, is the light on, current temperature inside the house, temperature in Belgrade, alarm armed, alarm disarmed, check mail, check notifications, convert Dinars to Euros and commands for sending SMS messages and e-mails. Each voice command will give a feedback to the user in a voice format.

Augmented reality is integrated as a part of mobile application. Users can use their mobile phone to scan the marker to get insight in state of sensors in virtual space. When marker is detected, Raspberry Pi reads the value from sensor and sends this information to mobile application, which shows this value above the marker. Value of the sensor is visible only through the phone camera. Text to speech application and augmented reality is shown in Figure 5.

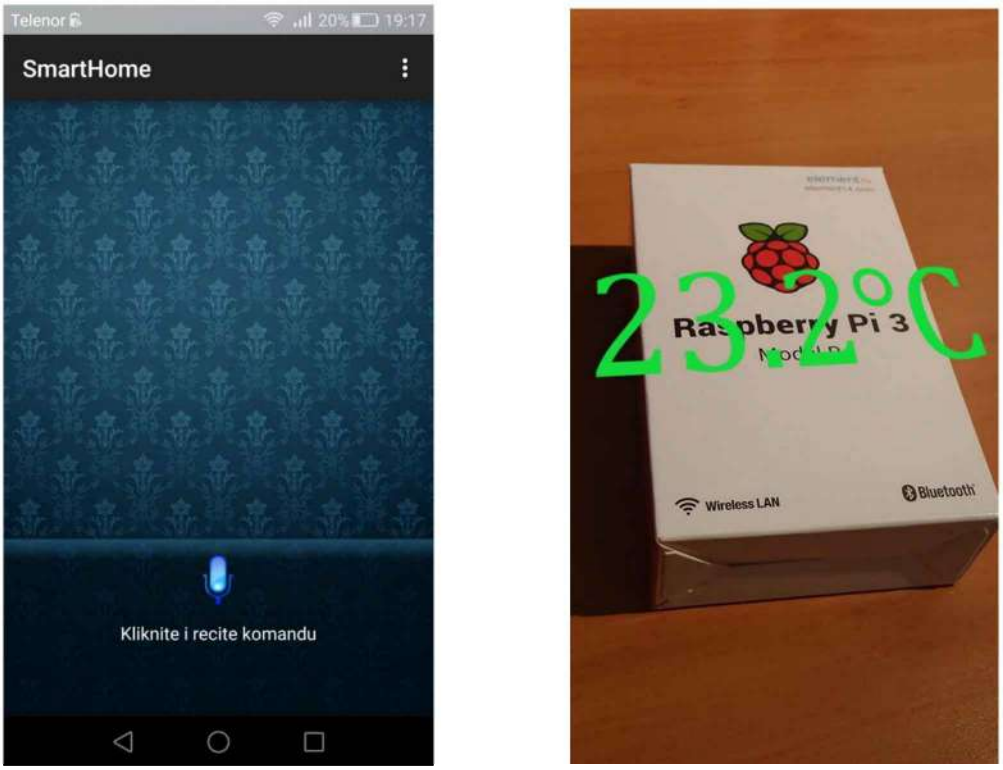


Figure 5: Text to speech application and augmented reality

Android application is developed in Android Studio IDE development environment. Within application is integrated Google's API for SpeechToText, which goes to Google's server and converts speech to text. Text is returned to Android application which sends it further to the web service on Raspberry Pi microcomputer, from which it gets feedback about executing proper action. Application notifies user in two ways, in text and voice formats.

5. CONCLUSION

This paper shows a solution for managing the smart house through voice commands. Model architecture is defined and implementation is shown through development of web and Android application. Advantages of shown solution are simplicity, low price of the equipment and possibility of easy

implementation in other smart environments. Shown application can significantly ease life of people with disabilities, and it represents complete solution compared to the other analysed applications. Applications analysed during writing this paper are focused on certain parts of the smart environment while defined application has control over most of the elements of smart houses.

During development we used large number of technologies and programming languages (Linux, Python, PHP, Android, Mongo, Vuforia) which is at the same time a flaw and virtue of the application. This work proves that large number of technologies can be used simultaneously to achieve concept of smart environments, but if application keeps developing it is necessary to limit the number of technologies.

Further development of the application can go in two ways. First way is expanding number of supported sensors and actuators. This way of development has no limits because it is possible to implement all devices that can communicate through the Internet. For example, we can create a smart heating system which would read information from different sensors and then control temperature and thus significantly decrease costs.

Other way of application development is focusing on augmented reality. It is believed that virtual/augmented reality is next step of human-computer interaction (Dong, Hyun, Jae and Jae, 2016.) so this way of development can be very interesting and challenging. It is possible to develop mobile application so that all information are shown in virtual space. Besides insight in current state, user can activate certain devices, so with only one gesture of the hand it's possible to manage music volume in whole house or shut down the light only by looking at it.

REFERENCES

Alejandro J., & Nicu S. (2005). Multimodal human computer interaction: A survey. ICCV Workshop on HCI. Beijing. 1-15, vol. 108, no. 1-2.

Cook D., & Das S. (2005). Smart Environments: Technology, Protocols and Applications. Wiley-Interscience. ISBN 0-471-54448-5.

Cyrus D., & Nayak A. (2016). MongoDB Cookbook, 2nd Edition, Packt Publishing.

Dong W. S., Hyun K., Jae S. K., & Jae Y. L. (2016). Hybrid reality-based user experience and evaluation of a context-aware smart home, vol. 76, 11-23.

Enisa (2015). Security and Resilience of Smart Home Environments, ISBN: 978-92-9204-141-0. doi:10.2824/360120.

Hanne G., Ovidiu V., Tracey C., & Roy B. (2012). A wireless sensor network for intelligent building energy management based on multi communication standards – a case study, ITcon vol. 17, Retrieved April 2016, from http://www.itcon.org/data/works/att/2012_3.content.00598.pdf

Intille S.S. (2002).Designing a home of the future. IEEE Pervasive Comput. 1, Volume 1, Issue 2.

Juniper research (2014). Smart Home Ecosystems & the Internet of Things Strategies & Forecasts 2014-2018. Retrieved April 2016, from http://www.connectedplusshow.com/assets/she14_wp.pdf

Kim J., Wang Z., Weidong C. T., & Feng D. D. (2007). Biomedical Information Technology, ISBN: 978-0-12-373583-6.

Makonin S., Bartram L., & Popowich F. (2013). A Smarter Smart Home: Case Studies of Ambient Intelligence. IEEE Pervasive Computing 12, vol. 12, no. 1, 58-66.

Moller S., Krebber J., & Smeele P. (2006). Evaluating the speech output component of a smart-home system. ISSN :0167-6393, doi: 10.1016/j.specom.2005.05.004

Tan L., & Wang N. (2010). Future Internet: The Internet of Things, 3rd Int. Conf. of Adv. Comput. Theory Eng. (ICACTE), vol. 5, V5-376-V5-380.

Uma S. T., & Tanveer J. S. (2012). Speech, Image, and Language Processing for Human Computer Interaction: Multi-Modal Advancements, ISBN13: 9781466609549, doi: 10.4018/978-1-4666-0954-9.

Weiser M., Gold R., & Brown J.S. (1999). The origins of ubiquitous computing research at PARC in the late 1980s.

Wu M., Lu T-J., Ling F-Y., Sun J., & Du H-Y, (2010). Research on the architecture of Internet of Things, 3rd Int. Conf. of Adv. Comput. Theory Eng. (ICACTE), vol. 5, V5-484-V5-487.

SMART BUILDING, THE NATIONAL BANK OF SERBIA

Goran Bjelobaba[1], Ana Savić[2]
[1] The National Bank of Serbia, Belgrade, goran.bjelobaba@nbs.rs
[2] The School of Electrical and Computer Engineering of Applied Studies, Belgrade, ana.savic@viser.edu.rs

Abstract: *This paper describes the advantages of using technical and technological achievements and their implementation in a centralized and integrated management system of smart buildings. It also defines smart buildings and gives basic features, functionality, and integrated management and monitoring by implemented technical systems, which contributes to saving energy consumption. It gives an example of an integrated technical system of a smart building of a business premises of the National Bank of Serbia.*

Keywords*: smart building, automation, technical systems, management, energy*

1. INTRODUCTION

Climate change, which is an active topic today, marks above all the negative consequences of the impact of humanity on the factors of the climate system. More than 40% of the global energy (mostly made of fossil fuel) is consumed in commercial and residential buildings. The goal of any construction is to provide conditions for life and work in economically acceptable conditions in complete harmony with nature. Using technology and processes for creating a building that is safer for its users and more effective in operational terms for its owners is more frequent. There is a need for automating business-residential facilities primarily with the aim of saving energy. The intelligence deployed at buildings, together with the integration of renewable generation sources, has brought in new concepts, such as Smart Buildings and Smart Environments. These new environments imply deploying interconnected sensors and intelligent devices in order to obtain energy efficient buildings (Smart Buildings) and make the life of the users easier (Smart Environments) (Hernandez et al., 2014:1462).

Smart buildings can automatically adjust its internal temperature or the temperature of each specific entity within to external conditions or to interior inactivity in individual parts by automatic control of heating, cooling and ventilating. The same principles apply to other subsystems that integrated and centralized system management controls, such as interior, exterior and facade lighting, access control, fire alarm system and air quality control system, monitoring security system, pumps control, generators, elevators, fuses, windows and other equipment in the building (Kambić, 2014).

Smart building can be controlled by: PC, tablet, mobile or landline phone, universal remote control and other modern devices that have the ability to receive and send executive signals. The primary task of the embedded automation is to satisfy the need for better quality of a modern man`s life, but at the same time to accomplish significant energy savings. In achieving the optimum balance between these two apparently correlative sizes, automation achieves its full meaning and usefulness. Finally, the concept gets its full meaning by creating a safe, comfortable, economical and secure environment, while simultaneously saving energy, reducing maintenance costs, and longer life cycle of the equipment.

2. SMART BUILDINGS

Smart buildings are those objects with built in materials and systems that contribute to lower energy consumption and simplify the operation of all equipment. Office buildings, hotels, hospitals, schools and housing facilities are in need of cost savings and greater comfort.

The brain and central nervous system of the smart building consist of central computer servers and databases, which gather large amounts of information, which are analyzed, processed and consequently sent to executive devices that carry out activities. Numerous and various sensors and cameras are surrogates for the senses, which collect information and initiate action, where the blood circulation, neural networks or spinal cord could be imitated by some of the protocols and buses for the transfer of data and control signals, while many zonal controllers represent a kind of peripheral nervous system. Finally, there are the Internet and Intranet networks that connect individual organisms with the entire community (Marković, 2010:285). Central system for managing the building (Building Management System - BMS) refers to a large

number of management systems in the building, from special purpose controllers to larger systems that include central computer and printers. BMS consists of several subsystems that can be connected in different ways in order to form a complete system, such as a system for heating, ventilation and air conditioning, electrical systems, lighting system, fire alarm system, security system. BMS can be used for monitoring, control and management of the entire system or parts of the system.

The basic need for the introduction of the BMS:
- Increasing the reliability of technical systems;
- Reduction of costs;
- Increasing the productivity of employees;
- Increase the safety of employees and property.

Centralized and integrated building management aims to make possible proper work of implemented technical systems with a minimum number of fails. The fails in the system components almost always require higher costs due to repair or replacement, than would be required with the periodic maintenance. Additional costs are caused also by the interruption of business processes due to the fail of individual components or the system as a whole. In this sense, BMS makes a significant contribution by continuous monitoring and preventive maintenance of components.

BMS communication network that is installed throughout the building is used for reception of all alarm signals and sending executable commands. By using an integrated system in a quick and easy way, we are able to provide comfortable conditions for work and, with these positive effects, influence the increase in employee productivity.

3. SMART BUILDING – THE NATIONAL BANK OF SERBIA

In the mid seventies, it was decided that, for the purposes of the former National Bank of the SFR Yugoslavia, a new office building would be constructed on Slavija Square, in Nemanjina Street. It was officially put into operation on 21 March 2006. The decision that the building should be constructed was made by the Council of Governors of the former Yugoslavia in 1976, and a detailed urban plan for area of "Slavija" from 1980 determined the location of this building. The investment program was discussed for 9 years and finally adopted in 1989. With the dissolution of SFR Yugoslavia, the National Bank of Serbia inherited all the problems and costs associated with construction. Construction started in 1992 and it was attended by about 60 companies.

Figure 1: Office building of the National Bank of Serbia, Nemanjina 17, Belgrade

The building is an imposing modern building of about 53,000 m2, with four underground and eleven floors above ground. On four underground floors there are parking, warehouses, safes, printing office, power stations, diesel generator, various workshops and the like. At eleven floors above ground, in addition to the three cabinets for vice-governors and office space, there is a hall with 200 seats, a specialized library, a safe for numismatics, as well as centers for facility management and security, kitchen and restaurant.

This facility has modern equipment for security systems, KGH control, telecommunication systems, access control, lighting control, multimedia systems, electrical control system, the system of structured cabling, IP

network and the Internet, management and visualization, integrated BMS software and systems for special purpose facilities.

3.1. Electronic security facility

The electronic security system of the building of the National Bank of Serbia in Slavija consists of multiple systems that are inter-related by hardware and software, which is managed and controlled individually and is supervised centrally via SMS system (Security Management System) that other systems are hierarchically subordinate to.

Electronic security system consists of the following systems:
- Anti-burglary system;
- Closed-circuit television (CCTV);
- Access control;
- The system for managing and controlling the status of doors in restrictive areas;
- Central monitoring of the security systems.

3.1.1. Anti-burglary system

Anti-burglary system consists of the computer, central units, operating consoles, gateway, printer, address input elements, address control elements, sensors, cable installations and components for assembly.
There are two anti-burglary panels with 8 addressable loops each, out of which 14 were used. The panels are located in the Control Center (KOC – Kontrolni centar), under the supervision of employees from physical and technical security (FTO) and anti-fire alarm security (ZOP) departments. Supervision of the work of the entire system as well as the management is carried out via a PC which is also in the Control Center. There is a gateway for the concentration and flow of information between the panels, PC and central monitoring system. Address loops connect 176 addressable elements with four addresses or about 700 zones. The loops are fully controlled and monitored.

There are sensors installed, such as infrared ultrasonic motion detectors, passive infrared motion detectors, glass break detectors, ambient, seismic detectors, alarm rails, magnetic contacts, alarm buttons and other. Sensors are installed in all places where it is possible or where unauthorized entrance is expected into the building premises and facilities whose content and purpose is of special importance. Installation is carried out with halogen-free signal cables. Installation and distribution cables are laid at S shelf of the cable tray envisaged for the installation of weak electricity. The power supply for central units is realized via rechargeable batteries that are found in panels or through diesel generators.

PC Computer and Gateway is powered via UPS placed in the room of the Control Centre. This system allows for each event or incident, either automatically or after a call of the operator to get a graphical representation of the micro and macro location of the incident, emergency plan and the like. Anti-burglary system is connected with hardware connections (RO-PP) with a CCTV system so that the selected monitor gives an image of the place of incident.

3.1.2. CCTV

CCTV system is designed for video surveillance of all entrances to the building, perimeter (adjacent to the building), protective inner circumferential channels in the underground part of the building, entrance halls and vital corridors, communication in underground garages, entrances to the premises and the rooms with vital contents regardless of their type, doors in restricted areas, area in front of the treasury, and the like. There is video surveillance system consisting of a central video matrix 176/32, 2 PCs, 10 quad processors, 4 multiplexers, 11 digital video recorders, video printer, monitor wall (6x55"), the power block for continuous operation (RO-E and UPS), 155 camera places in the building, 46 infrared reflectors, cable installation, components for assembly.

Central units are located in three RACKs in the Control Center where there is 24-hour duty. The CCTV system, besides permanent control, responds to each incidental situation so that the monitors show images of the incident area. The system performs continuous capture of images from all the cameras to digital hard recorders which are high quality and reliable. All cameras and video monitors are in color, except the cameras in circumferential channels, which are black and white and communications that have the ability to transfer from black and white to color, depending on the brightness levels. There are also IC reflectors that provide visibility to the cameras even in complete darkness. The position and optics of the programmable cameras can be controlled remotely from a PC (RO-DK).

CCTV system is connected with hardware connections to the anti-burglary system (RO-PP) and the interphone system (RO-I), and via the central monitoring system with the access control system for the management and control of the status of doors in restrictive areas (CF9000) so that the selected monitor shows the image of the incident place.

3.1.3. Access control

The system is designed to control entry to the building, certain facilities and premises of importance. In addition, this system registers time attendance and movement of the employees in the Security Department during regular facility checks. This system controls access to more than 90 doors in the building. The system consists of a PC, hub, 31 controllers, "proximity" readers, fingerprint readers, "proximity" card and cable installations. Central PC controls the system, receives data from the reader and programs the right to use employee cards. Central PC is located in the Control Center and the terminals at checkpoints are connected through an autonomous computer network of the facility.

PC Computers are powered by the UPS, while controllers have their own rechargeable batteries and are powered via a diesel generator. Through the CF9000 system, access control system is integrated into the central monitoring system for facility security. Access control system is connected to the system for calculating the salaries through the computer network of the facility.

3.1.4. The system for managing and controlling the status of the door in restricted area

This system includes a door that is security door (locked permanently or outside working hours) and, in case of fire, it serves as an evacuation door (continuously open), and doors which require remote control from the Control Center (lock/unlock), which have a special regime of entry, chamber door at the entrance to the area pertaining to the Control center, at the entrance to the very center, at the entrance to count rooms, the revolving door at the entrance to the building and others. The system operates and controls 29 doors in the underground area, 10 facade evacuation, 11 in restrictive areas above ground, 3 pairs of chamber doors at the entrance to the Control Center area, at the entrance to the very Center, at the entrance to count rooms, and 6 rotating doors at the entrances to the building.

The doors are equipped with special electric or electromagnetic locks that automatically or manually unblocked remotely, via the automatic fire detection system, the control board or a personal computer through which it continuously monitors the status of the doors. Command desktop, personal computer and the controllers are located in the Control Center. Through modules for data acquisition, CF9000 system for managing and controlling the status of doors in restrictive areas is integrated into the central monitoring system for facility security.

3.1.5. Central security monitoring system

Central facility security monitoring system (Security Management System) is the integration of all the above mentioned systems in a single unit. The electronic security of the facility of the National Bank of Serbia, on Slavija, consists of multiple systems that are inter-related with hardware and software, which is managed and controlled individually and supervised centrally via the central monitoring system which other systems are subordinated to. Central monitoring system, the so-called LMSmodular system from Siemens, which is used in the building, consists of a central communications gateway (GW20.08) LMSModular software package (V2.46), two workstations (PC of high performance), protocol and a graphic printer and software license for employees control system and license PAK. All the equipment of the central monitoring system is located in the Control Center.

The central communication gateway GW20.08 provides network management, which consists of 8 different sub-systems and up to 4 workstations. Subsystems are two central devices for signaling burglaries and raids, central video matrix, the controller network of controller access (31 controllers), digital input/output system for connection to the control system of evacuation and security doors, and it can optionally connect fire-alarm system. Two units are connected to the Central monitoring system as workstations, one unit of the anti-burglary system and a network of units of access control system. The system can be easily expanded to support up to 20 subsystems in one-stage configuration, and up to 80 subsystems in a two-stage configuration.

Connection of the CCTV and the central system

As part of an integrated system of electronic security, the project envisages connection between the CCTV system and central monitoring system which is carried out via the appropriate port on the workstation for interactive and graphical access to all the electronic security systems, via a central communication gateway. The operator has the possibility to display the desired camera on the selected monitor by issuing a command or simply by clicking the mouse. Also, the operator should receive all the alarms from a central matrix, and should also have the possibility to certify and reset them. Color graphic terminals with the text part display automatically, after the outbreak of the incident, the location and layout of the facility, the base of each floor to the level of the said premises and, after the call of the operator, the image from the camera that monitors the endangered area. On the basis of any level, there are symbols that affect or form an integral part of the facility security system.

Connection of anti-burglary system and central monitoring
At the level of central monitoring of the microprocessor burglar alarm control panel, connection is made via the appropriate port to a workstation for interactive and graphical access to all the electronic security systems, via a central communication gateway. Color graphic terminals with the text part display automatically, after the outbreak of the incident, the location and layout of the facility, the base of each floor to the level of the said premises and, after the call of the operator, the image from the camera that monitors the endangered area.

Connection of the access control system with the central monitoring
At the level of the central monitoring system, the access control is connected via the appropriate port to connect to a workstation for interactive and graphical access to all the electronic security systems, via a central communication gateway. Color graphic terminals with the text part display automatically, after the outbreak of the incident, the location and layout of the facility, the base of each floor to the level of the said premises and, after the call of the operator, the image from the camera that monitors the endangered area.

Connection of system to manage and control the status of evacuation and security doors in restrictive areas with the central monitoring
At the level of the central monitoring system, the system to manage and control the status of evacuation and security doors in restrictive areas is connected via the appropriate port to connect to a workstation for interactive and graphical access to all the electronic security systems, via a central communication gateway. The corresponding number of status information from the system to manage security and evacuation door will be collected via a digital multiplexing i/o system. Color graphic terminals with the text part display automatically, after the outbreak of the incident, the location and layout of the facility, based on each floor to the level of the said premises and, after the call of the operator, an image from the camera that monitors the endangered area.

3.2. Automatic fire alarm

Automatic fire detection system protect all areas except sanitary and toilets, their hall, the waste channel, circumferential channels that are flame-resistant and space between floors that have the following characteristics:

- Ceiling height of less than 0.8m;
- No lines for security devices;
- The units which have maximum dimensions 10x10m;
- The fire load of less than 25MJ/m2.

In particularly high-risk areas, inergen fire extinguishing or fire fighting sprinkler systems with water or ansulex fire extinguisher is activated. In spaces that are extinguished with inergen, there is complete protection with automatic fire detectors that automatically trigger the extinguishing. In the space which is equipped with water sprinkler systems in the underground part of the building (it is activated by thermal ampoule), automatic fire detectors are not provided. In these areas, there are handheld fire detectors and automatic report of the fire through registering extinguishing using signals from indicators at the appropriate fire-alarm report panel. In the space which is equipped with water sprinkler systems in the above ground part of the building (it can be activated with thermal ampoule),it has also the fire alarm systems with automatic fire detectors and extinguishing registration using signals from indicators at the appropriate fire-alarm report panel. Flow indicators are arranged so as to correspond to the fire sectors. In space where fire is extinguished with ansulex in the thermal kitchen, and are activated automatically or manually, regardless of the applied system of automatic fire report, automatic fire detectors are not provided, but registering the beginning of fire extinguishing with the signals from the control cabinet. Due to the exceptional importance of the object, as well as the high concentration of equipment and a big number of employees, devices of the latest generation of microprocessor technology are implemented.

This system includes the following equipment:

- In the place of possible fire incident, setting up "intelligent" fire detectors uniquely addressed;
- D-BUS to connect detection lines;
- Anti-fire panels (PPC);
- Control console located in the Control Center and the intervention group;
- C-BUS to connect the PPC;
- Concentrator (gateway) for communication between panels with workstations;
- Workstations;
- Relay module for the management of systems for secondary fire protection;
- Input module for the confirmation of executive functions or the status of the door.

Consequently, a distributed system of organization of the panels for automatic fire detection and extinguishing activation with inergen was implemented. There are two communication C-BUSs, which form two independent loops, one for alert report, other one for the activating fire extinguishing. Each loop is closed physically through two vertical ascents. This solution provides a high degree of safety in systems in case of accidents and outages of devices, for example cable break on the C-BUS is immediately registered in the central panel, and communication is continued, even in the event of total failure, C-BUS PPs continue individually with their autonomous operation. This solution is applied to the detection line, D-BUS's.

Logical and physical structure of the applied system are completely separate, which allows the actual physical structure, i.e. detectors to connected in lines with the rational management of cables (shortest route), and within logical structures to be addressed and grouped in a software-defined fire zones and fire sectors that further dictate executive functions of PP systems.

3.3. Chiller plant room

The facility also includes two independent chiller plants depending on the work regime of individual consumers who use cooling energy. Chiller plant 1 is used for providing cooling energy of all spaces for general purpose (offices, halls, restaurant, etc.). Chiller plant 2 is used for providing cooling energy to the computer center and other facilities which operate 24 hours (on-call service, etc.).

Chiller plant 1
It consists of water-cooled centrifugal chillers. There are three chillers with power of 754 kW. The units are parallel connected. Through the evaporator of each aggregate, flow is made with independent pumps. The flow through the network to the consumer is achieved with network pumps. Terminal units (chillers) are regulated via motor pass-through valves which gives a variable flow in the network. Some of the chillers are provided with three-way motor valve which prevents the possibility of network pumps working without the flow. There are three possible network pumps (two working, one standby) with variable flow. Variable flow rate is achieved by changing the pump speed by varying the frequency of the power supply. Water for cooling the chiller condenser is prepared in cooling towers placed on the roof of the building. There are three cooling towers (one for each aggregate) coupled in such a way so that each of the three towers can work with any unit. The towers are controlled via two-speed fan. Prior to filling the water in the towers, there is chemical treatment in terms of adding polyphosphates to prevent the formation of scale and dosing of biocides to prevent the formation of algae. The pressure in the system is made through the water pressure booster system with pumps with overflow safety valve and the water tank.

Chiller plant 2
It consists of two air cooled chillers located on the roof of the building. Chillers have additional heat exchanger for cooling water in winter mode without the compressor ("free cooling"). The chillers are packaged type with built-in centrifugal pumps and expansion vessel. Within the cold water, the system is filled with a mixture of water and glycol of concentrations of 35% in order to prevent freezing in winter mode.
Cold water from these aggregates supply chillers of air-conditioners in the computer centre and chillers of chambers of duty services.

In summer mode, cooling energy is provided by compressor operating in aggregates. In the transition regimes, cooling energy is provided in part through the "free cooling", and in part with compressor operating in the winter mode only via "free cooling", without the compressor. Since this chiller plant cools locked rooms with a large internal heat gains that require cooling throughout the year, such mode of operation provides the maximum operating economy.

3.4. Electricity lighting management

Management of electric lighting is done:

- Locally via pushbuttons and pulse switches;
- Automatically (turning off) by the presence detector and microprocessor devices;
- Remote (turning on/off) permanently or periodically.

In most of the offices, there are two circuits to power lamps (network and diesel engine). For each circuit, there is a switch by the door which acts on impulse switch mounted in the junction box in the cabinet, in the false ceiling of the corridor. Touch switch is for voltage control of 230V, 50Hz and is a bi-stable device with a contact for signaling the status on and contacts for remote control. Local control is done by pressing the switch, where the light is on or off depending on the previous state. For the purposes of automatic control of FAN-COIL units in each room, there is one microprocessor device mounted below the parapet mask of the window. This device is used, besides regulation, for power savings, in such a way as to have one presence detector in each room, which is connected to the microprocessor device. In the event that nobody is present in the room for a certain time (adjustable to a desired value), the microprocessor device turns off the lamps. When re-entering the room, an employee may, if needed, turn on the light.

Remote control of the lighting in the offices is done through impulse commands, which are realized through a central system for remote monitoring and management of technical systems (CSNU). Control is performed as a function of time (time of day) and the reference brightness levels in normal working conditions in the facility. In case of emergency actions of the security services, the entire lighting in offices and other facilities on the floor can be activated. During the holidays, it can remotely turn on all the lights on the facade walls of the facilities.

Remote control allows that, in certain times of day and on the basis of the reference level of brightness, the electric lighting be reduced, in such a way that the impulse command turns off the first network light that is turned on, and then the light that is supplied through diesel generators. After turning off the light, it can be turned on again in every office locally as desired and needed.

3.5. Central monitoring and management system

For the purpose of automation of work, remote monitoring and management of technical systems in the facility, central system for monitoring and control is implemented (CSNU).

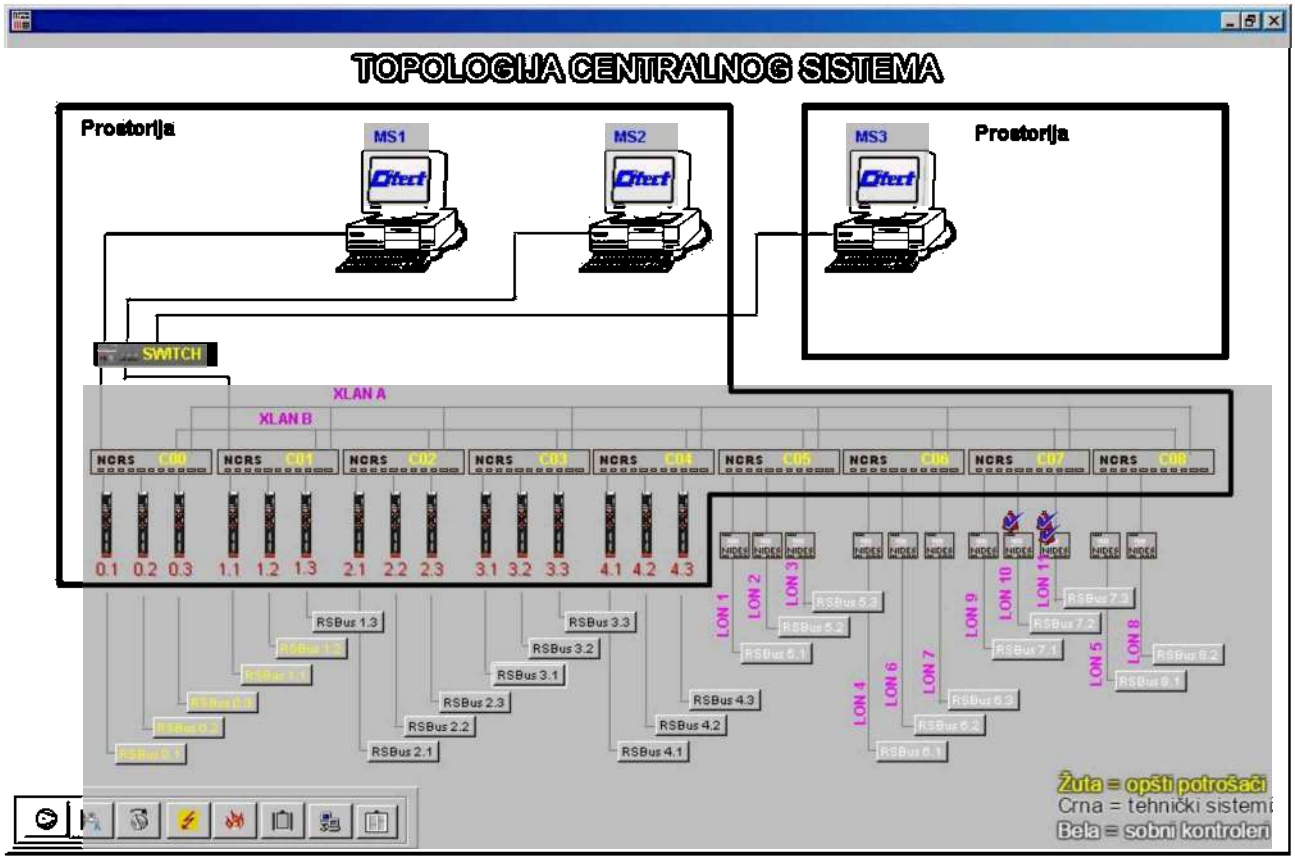


Figure 2: Topology of the central system (CSNU)

Central monitoring and management system (CSNU) performs the following functions:

- Remote control of all technical systems in terms of measurements (temperature, humidity, pressure, etc.); counting hours of operation, signage system operation (status), signaling the state of emergency, alarms (frost, motor protection, voltage failure, etc.);
- Remote software management of systems as a function of time and events;
- Direct (digital) control of parameters of the air and water to the desired set value with the possibility of remote control changes of the set value from the central computer;
- Optimization of consumption of heat, cooling and electricity (without disturbing the comfort conditions in the facility);
- Automatically collect data about conditions and events in the technical systems in time to analyze the work of preventive maintenance and servicing;
- The ability to represent the operator, in real time, all events on the color display in the form of a dynamic images with the current conditions of controlled sizes;
- Automatic printing and the protocol of the printer;
- Display graphics based on data collected in time;
- A modem (network) communication;
- Different levels of access to system functions depending on the jurisdiction.

The central communication gateway GW20.08 provides network management with different sub-systems and workstations. Interactions are possible between the subsystems connected directly to gateway and the locally connected I/O modules. Incoming messages can trigger one or more command messages to other subsystems.

Supported protocols:

- CDDL/CMSDL for LMS/CMS — up to 9600 baud;
- Cerban (CZ10, CC11, CS4, CS440, CC6, CC60) — 300 or 600 baud;
- ISO 1745 MK-7022/Cerloop — 1200 or 2400 baud;
- CMX-DL — up to 9600 baud;
- CCTV Burle (Philips-Burle) — 1200 baud;
- CCTV Siemens — 9600 baud;
- SEEP (Westinghouse SExxx) — up to 9600 baud;
- CerPass — up to 9600 baud;
- CDDL/CDSF (other control units) — up to 9600 baud;
- Stäfa port V2.0 or V3.0 NISE — 9600 baud;
- CDDL/CDSF FHI-pad (other host) — up to 9600 baud.

4. CONCLUSION

The energy crisis and the need for energy conservation, has resulted in a very rapid and remarkable development of technical systems that help us to effectively manage energy consumption. Buildings are the single largest consumers of energy, and thus the major pollutant of the environment.

Serbia is in Europe one of the countries with the highest level of energy consumption in buildings. The middle consumption per square meter of the building is about 2.5 times higher than in northern Europe, while half of households consume 340 kWh/m2 per year, which is 3 times more than in Western Europe. Chronic diseases, including respiratory diseases, are directly linked to significant pollution of the interior space. Serbia has an international obligation to save at least 9 percent of gross final energy consumption by 2018, and it should also reduce carbon dioxide emissions by the same amount by 2030. Using scientific and technological development, we are able to save significant amounts of energy in buildings.

The system for automatic control of smart buildings accounts for only three per cent in the price of the facility, and after five to seven years, it begins to "to earn". The savings that the system can achieve is in a range of 15 to 35 percent. If it is a large business facility, such as building of the National Bank of Serbia in Belgrade, there are huge savings in money and energy consumed. With automated and integrated technical systems, we realize significant cost savings and energy consumption, but also increase comfort. With the development of internet technologies (ADSL, cable DSL, satellite and mobile internet, etc.), there is a possibility of connecting smart buildings to the Internet and remote access devices in the system. This means that in a

simple way, wherever you are, you can access any device in the system to obtain information about the current status of all devices and control any of these devices.

REFERENCES

Radenković, B., Despotović-Zrakić, M., Bogdanović, Z., Barać, D., i Labus, A. (2015). Elektronsko poslovanje. Beograd: Fakultet organizacionih nauka.

Hernandez, L., Baladron, C., Aguiar, J. M., Carro, B., Sanchez-Esguevillas, A. J., Lloret, J., & Massana, J. (2014). A survey on electric power demand forecasting: future trends in smart grids, microgrids and smart buildings. Communications Surveys & Tutorials, IEEE, 16(3), 1460-1495.

Buildings Energy Data Book. US Department of Energy, (2011). Retrieved from http://buildingsdatabook.eren.doe.gov

Kambić, M. (2014). Veštačka inteligencija upravlja objektima - "Pametne" zgrade, manje energije za veći komfor. Preuzeto sa http://www.ekapija.com/website/sr/plainPage.php?id=995308&tb=e

Tomić Vasilić, J. (2009). Pametna kuća. Preuzeto sa http://mehatronika.gomodesign.rs/pametna-kuca/

Elektro projekat izvedenog objekta, Projekti integralne elektronske zaštite, Mapa 1- opšta dokumentacija.

Elektro projekat izvedenog objekta, Projekti integralne elektronske zaštite, Mapa 2 - protivprovalni sistem .

Elektro projekat izvedenog objekta, Projekti integralne elektronske zaštite, Mapa 3 - nadzorna televizija (CCTV).

Elektro projekat izvedenog objekta, Projekti integralne elektronske zaštite, Mapa 4 - kontrola pristupa.

Elektro projekat izvedenog objekta, Projekti integralne elektronske zaštite, Mapa 5 – sistem za upravljanje i kontrolu statusa vrata u restriktivnim prostorima.

Elektro projekat izvedenog objekta, Projekti integralne elektronske zaštite, Mapa 6 – centralni monitoring sistema obezbeđenja.

Marković, D. (2010). Procesna i energetska efikasnost. Beograd: Univerzitet Singidunum.

symorg 2016
RESHAPING THE FUTURE THROUGH SUSTAINABLE BUSINESS DEVELOPMENT AND ENTREPRENEURSHIP

AMBIENT INTELLIGENCE TOOL FOR MULTIMEDIA USER PROFILING

Igor Đurić*[1], Zorica Bogdanović[1], Božidar Radenković[1]
[1]Faculty of organizational sciences, University of Belgrade, Belgrade,
*Corresponding author, e-mail: igor@elab.rs

Abstract: *This paper presents a model for creating a multimedia user profiling tool. The idea is to create an open source profiling tool that is mainly for developers and users with advanced computer knowledge Multimedia user profiling tool should be a very important part of a personalized intelligent home media center. Presented model is Linux based, easy to implement and easy to enhance. Additional user profiles can be introduced and existing ones can ban configured on a way user wants. In addition, rules for certain behavior can be configured and rules can be assigned to a user profiles. System is using ambient intelligence as well as rich users' database to record environment variables and user's behavior in correspondence to the variables. Presented model is distributed and each of the components has its own settings and it can be easily configured, enhanced or, even, replaced with a new component. At the end, system is using external APIs to gather the data about the movies in order to find an appropriate content for the user and to offer multiple movie titles for the user. Default system settings are using Netflix API, OMDB database and movies trailers API.*

Keywords*: Ambient intelligence, user profiles, artificial intelligence, smart home, multimedia center.*

1. INTRODUCTION

This paper presents a model for creating multimedia user profiles based on user habits, free time, expectations and things users like. Presented profiling tool should be a part on a personalized intelligent home media center. The idea is to track user's behavior, habits and all accessible data about the user in order to create a user profile that is as rich as possible. A well-formed user profile gives an opportunity to offer an appropriate multimedia content to the user. Also, predefined user profiles can offer new users a content that might be interesting to them. That means, for example, if user loves to watch thrillers with a good IMDB grade on Friday night, exactly that kind of content should be offered to the user. The tool should store all the data that can be found about the user. In that purpose, a lot of external APIs should be contacted. External APIs connectors should be modular and easy to develop and configure. In that purpose social network APIs (LinkedIn, Facebook, Twitter...) and as well as others accessible (YouTube, forums...) APIs are contacted and used. Introducing new APIs is easy configuration part of the system. Tool is, on scheduled time, contacting all available APIs and gathering the data about the user. Data is stored in MySQL database which is implemented on a very modular way. User profiles and prediction rules are available in the system. Second peace of the puzzle is user's behavior. Each time user plays some multimedia content, content length, genre, age, actors, producers, etc., is stored as well as external factors such are time of the day, weather, date, amount of light in the room, etc... Combination of these parameters allows the system to track what user likes or dislikes. Also, based on existing user's data and data gathered from external APIs, when new user is logged in, or a user without no too much data already stored is using the system, tool can automatically offer some multimedia content to the user which may or may not be appropriate to the user, but from the very beginning forces the user to enrich his profile. For displaying multimedia content and searching multimedia content database system uses external APIs. This part also is, also, very modular and easy to change. Default system configuration is using OMDB movie database and YouTube APIs to gather multimedia content data, Movie Trailer API for getting movie trailers and Netflix and YouTube APIs to play multimedia content.

2. LITERATURE OVERVIEW

Precise identification of users, their attributes and interests is the most important thing of the prediction and personalization systems. There are theories that say that what users do on social networks is highly connected with their interests and approaches in real life. For example, pictures users are posting on social networks can tell about their interests and how they feel currently. *You, Q., Bhatia, S., & Luo, J. (2015).*

User experience with some software is highly connected with how software adopts to the end-user. Categorizing users by their behavior and creating user categories out of their common habits brings end-user experience on a highest level and helps users easily adapt to the software. *Katerina, T., Nicolaos, P., & Charalampos, Y. (2014).*

With today's technique it's very easy to gather user's data out of everywhere. For example, new approaches are using a smartphone application to gather data about the user. Background applications that does not bother user are used to collect data about the user. Different sensors and components which smartphone has, such are GPS receiver and Bluetooth can be used in order to collect data about the user. *Eskes, P., Spruit, M., Brinkkemper, S., Vorstman, J., & Kas, M. J. (2016).*

User profiling is a commonly used approach. It helps users to feel comfortable using application, but it has some privacy concerns. Personalized informational systems and user profiles, bring on one side, great user experience, but on the other hand big privacy risks in terms of sharing your habits and data with third parties. *Parra-Arnau, J., Rebollo-Monedero, D., & Forné, J. (2014).*

Smart homes are becoming more and more common thing. But, now challenges are different. It's not anymore the idea to adopt users to a smart home. Now the idea is to have a smart home that adapts to the user. Smart home providers should survey needs of a user and create a smart home that fits user's needs. *Luor, T. T., Lu, H. P., Yu, H., & Lu, Y. (2015).*

Intelligent home media centers are becoming more and more convenient. Comparing to a classic home media center or a dvd player, an intelligent home media center has more options, better user control and user experience as well as better coverage of multimedia formats it can play. *Đurić, I., Ratković-Živanović, V., Labus, M., Groj, D., & Milanović, N. (2015).*

There are several researches about how user's mood can be connected with their opinion about some movie. For example, depending on user's current mood, they can like or dislike some movie. Also, depending on user's mood, users will want to watch different genres of movies. Recommendation approaches for movies should be changed and now it should take into the account user's mood in order to offer an appropriate content to the user. *Winoto, P., & Tang, T. Y. (2010).*

Choosing a movie to watch can be a boring and long work. It happens to users that they don't have any idea what they would like to watch and they cannot find a good recommendation online. One of the approaches for recommending appropriate movie content to the users uses hybrid combination of movie tags and ratings in order to offer the users a movie title they would like to watch. On that way time is saved and users can expect a movie title that could fit to their expectations,*Wei, S., Zheng, X., Chen, D., & Chen, C. (2016).*

Also, there are approaches using data mining in order to offer an appropriate movie to the user. One of such approaches uses as input arguments both movie attributes and user preferences in order to offer the right movie title to the user, *Thrasher, J. F., Sargent, J. D., Vargas, R., Braun, S., Barrientos-Gutierrez, T., Sevigny, E. L., ... & Hardin, J. (2014).*

Depending on a country we are, we can find different opinions are multimedia content appropriate for some users. For example, in some countries we can find an attitude that movies containing drugs, sex or violence are not an appropriate for young people to watch. On the other hand, in some countries that are more liberal such movies are considered an appropriate for all people to watch, *Moreno, M. N., Segrera, S., López, V. F., Muñoz, M. D., & Sánchez, Á. L. (2016).*

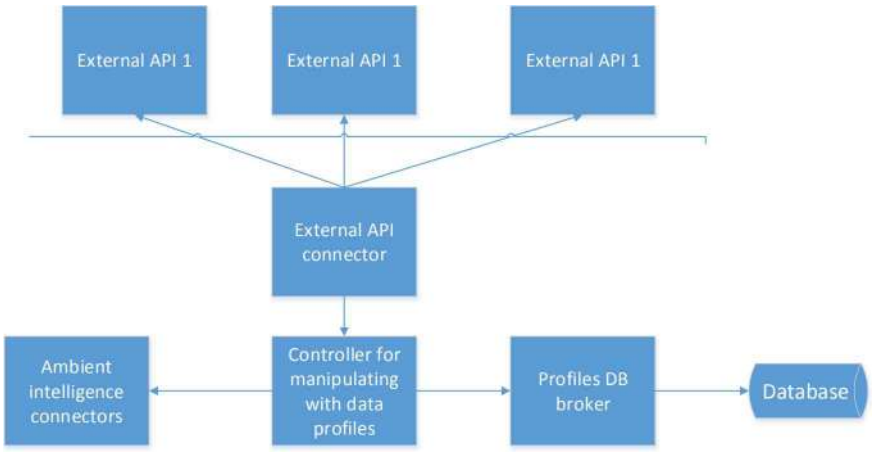
Thanks to increasing number of online multimedia services, users are each day less watching TV and turning to online TV services. Some of benefits online TV services are: watching what users currently want to watch, absence of commercials and some advanced features that are not present on the classic TV, *Lee, S. Y., & Lee, S. W. (2015).*

3. DEVELOPMENT

It is required to create a model for collecting user's data in order to make a user profiles database and a mechanism working with the database that is capable of distinguishing users by their profiles and to offer an appropriate content for the user based on his profile.

System should have the following components:

- External APIs connector
- Controller for manipulating with the data and profiles
- Ambient data collectors
- Profiles database broker
- Profiles database



Picture 1: System components

3.1. External APIs connector

External APIs connector should communicate with external APIs. It should represent the connection between Intranet and Internet. These APIs should be used to get the data that is appropriate to the user based on the requests received from profiles controller. External APIs connector should have a possibility to communicate with multiple APIs in order to get the content that is the most appropriate and as comfortable as possible for the user to evaluate and understand. External APIs connector does not need to have too much application logic behind it. It should have registrations for all the APIs that is contacting and order in which APIs should be contacted to maximize data quality and occurrence. On a high level of abstraction, we can split all contacted APIs to two major groups:

- APIs for collecting information about the user and
- APIs for getting multimedia content

APIs for collecting information about the user should be, mostly, social networks. These APIs should give the data about the user in order to find out as more as possible user habits, social and bio data.

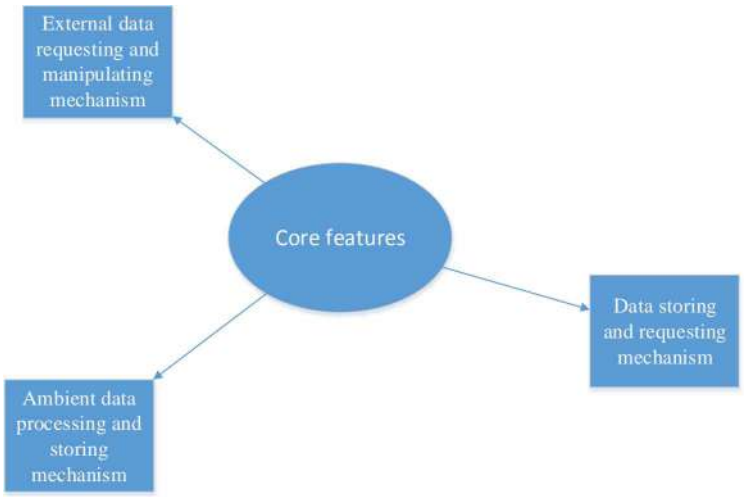
On the other hand, APIs for collecting multimedia content are not user specific. They should provide data such are movie trailers, movies and multimedia meta data such are IMDB grades, movie titles, length, directors, actors, etc.

3.2. Controller for manipulating with the data profiles

Controller for manipulating with the data profiles should do the most of „magic“. It should be the heart of the system and communicate with external APIs connector, profiles database broker and with all present ambient data collectors. Also, controller for manipulating with data profiles should contain all logic that is needed in order to process all the data.
It should contain several sub components:

- Data storing and requesting mechanism
- External data requesting and manipulating mechanism
- Ambient data processing and storing mechanism
- Core features

Model showing Controller’s components is displayed below:



Picture 2: Controller for manipulating with data profiles - components

The main idea of each of the components will be described in detail:

3.2.1. Data storing and requesting mechanism

Data storing and requesting mechanism will be in charge of communicating with profiles database broker. It should prepare data for sending to database broker to be stored or to prepare requests for getting data from the database broker.

Also, it should contain extensible components for mapping user profile data with the user habits. Data storing mechanism should have a possibility to store any data about the user.

3.2.2. External data requesting and manipulating mechanism

External data requesting and manipulating mechanism should do very similar thing as data storing and requesting mechanism, but with external APIs connector. It should prepare appropriate requests for external APIs connector and to manipulate with the data received from the external APIs connector.

3.2.3. Ambient data processing and storing mechanism

Ambient data processing and storing mechanism should process the data received from an ambient data collectors. It should investigate all the data, eliminate non useful and prepare all the data that could be useful for the system for sending to data storing and requesting mechanism.

3.2.4. Core features

Core features should balance with all sub components of controller for manipulating with the data. It should be „the brain„ of controller. All the data processed inside the controller for manipulating with data should be transferred over core features. That means that core features should be a connection between all other components in the controller for manipulating with the data profiles. This component should also have mechanisms to convert the data in all forms that are required to be understood by all other sub components of the controller for manipulating with data profiles.

3.2.5. Ambient data collectors

Ambient data collectors should receive all available data from environment and pass it to the controller for manipulating with data profiles. Ambient data collectors should be modular and easy to extend. These components should not contain any logic. They should simply transfer all collectible data to the controller for manipulating with the data profiles.

3.2.6. Profiles database broker

Profiles database broker should be a very simple component. It should be modular and easy to change or enhance. It should be unique for each database type that could be present in the system. Profiles database

broker should have CRUD operations implemented in order to allow core features to manipulate with the data from database.

3.2.7. Profiles database

Profiles database should be in a tight connection with the profiles database broker. Profiles database broker should communicate with the profiles database by storing data in the database and returning in on request from Core features. Profiles database should be implemented on a way that allows quickly getting the data from the database and easily storing the data.
Also, profiles database should have a structure that allows introducing new fields without changing the database structure. Structure should be implemented on a way that allows introducing new sensors, APIs and user attributes without a need for changing database structure or introducing new fields.

4. IMPLEMENTATION

This chapter explains how each of the components is implemented, in which technologies and why exactly each of the technologies is used and what benefits it has for the system. Common thing for all the components is that they are implemented on CentOS operating system. CentOS is chosen because it's stability, easy maintenance and big community that helps user's seeking for stable operating systems to find what they are looking for. All scheduled tasks are performed as cron jobs. For web interfaces Apache web server is used with modPERL because all the web interfaces are written in PERL. For frontend development HTML, CSS and JavaScript are used. Since system is made out of scalable components and it is not in user's interest that something goes wrong, a log of logic is placed on client side and it's a part of JavaScript code. This approach enhances scalability because it allows weaker servers to run the system because a lot of logic is done on a client side. Since, system is planned to be a part of internal user's network, there's no risk of hurting the system from the user's side. Also, Python programming language is used for collecting some data from the controllers.

For settings and configuration files XML notation is used. And, for web services, both REST and SOAP protocols are implemented in order to cover all the possible web APIs. Database engine that is used is MySQL.

4.1. External APIs connector

External APIs connector is a component made of one Perl script and several additional XML files. The idea is to allow users to register an additional API connectors. Since external APIs connector does not need to have knowledge on how to process received data, only thing it needs to understand is what to connect and what data to expect. That's why additional APIs can be registered as an additional XML files. PERL script, after receiving a request of which API to contact, replaces passed arguments with already defined placeholders and returns a response from an external API to the requester. It also has some mechanisms to prevent malicious data to enter.

Request can be sent out via two web service protocol REST and SOAP.
When new API is registered via XML, preferred web service protocol should be chosen. For contracting external APIs, this script uses REST::Client Perl library to contact REST services and SOAP::Lite library to contact SOAP based web services.
Preferred mechanism for replacing input arguments for web requests with data is through PERL template toolkit. Template toolkit is a Perl developers preferred way because it allows users to send different variables in any wanted order, as long as their names are unique. External APIs connector is returning a hash of response values.

4.2. Controller for manipulating with the data profiles

Controller for manipulating with the data profiles is also written in Perl and uses xml files for configurations as well as web interface. Each of the controller's components will be described in detail.

4.2.1. Core Features

Heart of controller for manipulating with the data profiles is core features. Role of Core features is to do an orchestration: to control all the other components and to contain all the logic on how to deal with user profiles. Since understanding of user's behavior can be changed, all conclusions and further actions after conclusions are configurable and easy to extend or maintain. This is done also through configuration files. User can add new configuration file or edit an existing one. Configuration files are XML files. Configuration file should contain the following information:

- Rule priority - As higher rule priority is, this rule will be considered more important.
- Rule conditions: List of conditions that should be accomplished or not accomplished In order for rule to kick in.
- Number of occurrences for rule to kick in: Depending on this parameter, rule will kick in when number of occurrences is breached
- Actions: Actions which will be performed after previous conditions are accomplished

Rules can be assigned to user profile. That means, if user has some profile assigned, all rules assigned to a profile will be applied for a user. User can have zero or more profiles assigned to him. Profiles are assigned when user's behavior is accomplishing all the profile conditions. Since checking profile conditions takes a lot of time and resources, it is done once per day on a scheduled time. Profiles rebuild script is running as a cron job.

For example, profile might be called "Youngster" and have the following conditions:

- User is younger than 22 years
- User has Facebook and Twitter profiles
- User is watching more than 70% his movies after 22h
- User is watching mostly comedies (more than 60% movies that user is watching are comedies)

Also, several default profiles are be provided. These profiles are used for users who still do not have a lot of data collected in the system. These rules are simpler and their main point is to predict how user will behave based on actions of previous users that used the system.

4.3. Ambient data collectors

Ambient data collector is an expandable list of the components. It contains one main script for running data collector files that are already configured. When new script is added, an xml registration should be introduced. XML registration contains name of the script that should be run and expected output data. For example, default setting contains script for amount of the light in the room. Each time user starts a multimedia content amount of light in the room is measured and stored. At the end, ambient intelligence data collector is returning all possible data information to the core features and waiting for a new request. When request is received, this component is opening all configuration files and running each of the configuration files on a selected way. Using PERL Template Toolkit is also supported.

4.4. Profiles database broker and profiles database

Profiles database broker is storing all collected data in the database. It is also returning all the requested data about the user. Profiles database broker represents a PERL script which is selecting the data out of the MySQL database. Script has only CRUD (Create, Read, Update, and Delete) operations. All additional and more complicated operations should be performed on the Core features side.
Since, user's data is highly configurable, only basic user information is stored in separate columns. All configurable user data is stored in one column in JSON format. On that way user's data can be easily expanded with new information without changing database structure. Database, by default, has only two tables:

- Users and
- UsersBehavior

Users table contains all the data about the users. It has several fields like user name, id, gender and date of birth and additional field called custom user data. Custom user data contains all custom user data collected by external APIs. This might be user's Facebook, Twitter on LinkedIN profile data as well as data user has entered manually through web interface.

Other table is called UsersBehavior. UsersBehavior has columns id, user_id, date_time and custom_data. Same approach for storing custom data in JSON format is used.

5. CONCLUSION AND FUTURE PLANS

Presented framework is an open source, easy to maintain, self-hosted solution.
Benefits that presented approach has are:

- If new social network is introduced, framework will easily adopt to it
- It can be easily combined with Internet of Things
- User can configure the system by his own needs
- System can learn from the users and as much it is used, it will work better

- Any movie player can be used with the system because prediction and play mechanisms are separated
- System does not require an expensive hardware
- It does not require licenses or any payments
- It is distributed in several separated units
- It is highly scalable and can work on almost the same way with any number of users
- Thanks to Linux operating systems in background, it is highly reliable and should not stop working in any conditions

Constraints of the presented framework are not big, but implementation like this definitely has them. They are the following: Since a lot of components are used and system is highly distributed, it takes a lot of developer's or, at least, Linux administration knowledge to setup the system. That's why this implementation won't be attractive to the users who do not have a big Linux knowledge. Other similar solutions have their own installers that are easy to run and setup. On the other hand, setting up a system like this will take several hours of setting up components and installing missing Linux packages System upgrade and setup is very easy thing to do, but it's not simple at all. To setup an additional API for receiving the data, user at least must understand XML files to setup host name to contact, web services to choose an appropriate way of contacting the service and PERL template toolkit in order to choose which components will be sent to the server and which will be received and how will they be processed Additional profiles are also a little bit complicated to introduce because they require XML knowledge and good prediction mechanisms in order to predict how system will react on new settings. Also, adding a wrongly configured user's profile could cause whole system to work on inappropriate way

Some extensions require Python or PERL knowledge in order to introduce additional data received from sensors and, optionally, to involve some actuators to make an environment more comfortable for the user

If we take all the previous points in to the count, we can say that presented framework is a highly configurable system, mostly made for power users who have a solid developer's knowledge. On the other hand, it's a nice starting point for new developers or students who do not want to start from stretch with creating their own implementations, but have nice ideas that could be easily implemented and could have some benefit in multimedia world. Since whole project is an open source and available to change or enhance, the author hopes that other developers will join the project and try to make it even better.

Similar solutions relay on heuristics and systems usually try to learn what user's want to see and get. Presented solution uses a different approach. Instead of telling users what they want, it allows them to configure what they want to get based on their behavior. This approach is harder, but it might lead to precise suggestions.

Similar solutions are mostly working like black boxes with their own APIs and hidden logic. Presented solution is fully opened to the users and tries to motivate the users to configure it by their own needs and wishes.

In future, framework should be much better and bigger. It should come up with fa lot of predefined profiles by default which could help users to start using the system on a right way after installation. It should also be preconfigured to work with several external APIs in order to help user's to set up the system by their own needs.

Regarding settings, new version should use web interface for introducing additional settings and profiles instead of XML files. Also, all other possible setting and configurations should be done through the web interface.

Since system installation is very complicated, system should, in the next versions, come with an installer which can install all the components on several Linux distributions, and as well, to setup it's own Linux distributions out of an image. It should also install automatically all dependencies and components in order to work on a default way.

And last, and maybe the most important thing to introduce in the system is a central Cloud storage for the data. Cloud storage should contain new profiles, rules, API connectors and scripts for manipulating with sensors. The main goal of this approach is to allow user to choose a component or a rule they like and to automatically install in from the Cloud.

Also, Cloud should work and vice-versa. Users should have an option to share their own code and settings in order to help other users to easily configure the system and to get the best possible user multimedia user experience.

New version approach should motivate users who do not have too much experience in development to start using the system and to interest them in multimedia user profiling.

REFERENCES

Đurić, I., Ratković-Živanović, V., Labus, M., Groj, D., & Milanović, N. (2015). Designing an intelligent home media center. Facta Universitatis, Series: Electronics and Energetics, 29(3), 461-474.

Eskes, P., Spruit, M., Brinkkemper, S., Vorstman, J., & Kas, M. J. (2016). The sociability score: App-based social profiling from a healthcare perspective. Computers in Human Behavior, 59, 39-48.

Katerina, T., Nicolaos, P., & Charalampos, Y. (2014). Human Factors in End-user Development of Marketing-IS: A Behavioral User Profiling Approach. Procedia-Social and Behavioral Sciences, 148, 245-253.

Lee, S. Y., & Lee, S. W. (2015). Online video services and other media: Substitutes or complement. Computers in Human Behavior, 51, 293-299.

Luor, T. T., Lu, H. P., Yu, H., & Lu, Y. (2015). Exploring the critical quality attributes and models of smart homes. Maturitas, 82(4), 377-386.

Moreno, M. N., Segrera, S., López, V. F., Muñoz, M. D., & Sánchez, Á. L. (2016). Web mining based framework for solving usual problems in recommender systems. A case study for movies' recommendation. Neurocomputing, 176, 72-80.

Parra-Arnau, J., Rebollo-Monedero, D., & Forné, J. (2014). Measuring the privacy of user profiles in personalized information systems. Future Generation Computer Systems, 33, 53-63.

Thrasher, J. F., Sargent, J. D., Vargas, R., Braun, S., Barrientos-Gutierrez, T., Sevigny, E. L., ... & Hardin, J. (2014). Are movies with tobacco, alcohol, drugs, sex, and violence rated for youth? A comparison of rating systems in Argentina, Brazil, Mexico, and the United States. International Journal of Drug Policy, 25(2), 267-275.

Wei, S., Zheng, X., Chen, D., & Chen, C. (2016). A hybrid approach for movie recommendation via tags and ratings. Electronic Commerce Research and Applications.

Winoto, P., & Tang, T. Y. (2010). The role of user mood in movie recommendations. Expert Systems with Applications, 37(8), 6086-6092.

You, Q., Bhatia, S., & Luo, J. (2015). A picture tells a thousand words—About you! User interest profiling from user generated visual content. Signal Processing.

USING BIG DATA ON LARGE DAMS

Rastko Martać*[1], Miljana Novarlić[2], Dušan Barać[3]
[1,2]Jaroslav Černi Institute for the Development of Water Resources
[3]Faculty of Organizational Sciences
*Corresponding author, e-mail: mrastko@gmail.com

Abstract: *Large dams are structures of great importance. Dams are used for power generation, irrigation, water supply and control of water flows. Improvement of the system for monitoring dams increases the number of data for collecting. Existing relational database can't handle large amounts of data and it is necessary to implement new technologies like big data, Cloud, Iot (Internet of Things). Use of Big data allows processing of large amounts of data in real time and it is possible to get real state of dam. The goal of this paper is to describe big data concept and present possible application of big data on large dams in order to improve the system for monitoring and data analysis.*

Keywords*: Big data, Large dams, Serbia, hydrology, monitoring, IoT*

1. INTRODUCTION

Process of monitoring and collecting data is very important for dam management. The collected data are used to predict the behavior of dam which is very important for dam safety management. Dam safety and reliability of instruments are affecting the entire eco-system in the area of the dam.
Risk of dam damage increases with dam age, so it is necessary to constantly improve the system for monitoring and dam safety, in order to avoid unwanted disasters (Association of State Dam Safety Officials, n.d.).
Most dams in Serbia were built in the 60s and 70s of 20th century. Most dams have monitoring systems which dates back to the time when the dams were built. Because of the age of dams it is necessary to improve the system for monitoring. One way of improving system is the implementation of big data concept in process of storage and data process. Big data is generated from everything what surround us in every moment (Big data, n.d.). It is produced by every digital process and exchange of social data. Systems, sensors and mobile devices are all used for data transfer. Big data comes from different sources with alarm speed in large volume and different variety. To process big data it is necessary to have computers with optimal process power, analytic ability and skills.

2. GLOBAL USE OF BIG DATA

Big data is a term which means large and complex sets of data, where traditional application for data process can't be used (B. Radenković, M. Despotović-Zrakić, Z. Bogdanović, D. Barać, A. Labus, 2015). Those sets of data are characterized by the diversity of formats, high speed processing and access and large amounts of information.
Big data have found different application in various fields. Further in the paper big data application in the world will be explained.
Rao, BBP et al. describes application of IoT (Internet of Things) in combination with Cloud and Big data (Rao, BBP ; Saluja, P; Sharma, N; Mittal, A ; Sharma, SV, 2012). Authors describe IoT as set of all data which surround us connected to the Internet. When all devices are connected to the Internet and between themselves, they enable complex and smart processes and services which give support our basic needs, economy, environment and health. Devices connected to the Internet offer different services which produce large sets of data and information. Cloud computing is explained by the authors as a model which enables on-demand access to shared configurable resources. Cloud platform enables access to the devices which surround us anywhere anytime. Application which communicates with devices like sensors, requires large storage to store big data, big process power to process data in real time and high throughput network which enables streaming of audio and video. In this paper, authors also describe Sensing as a service on Cloud which use several application like Augmented reality, Agriculture monitoring and environment.
Sowe, SK et al. explain appearing big data as key point of connecting between objects and things on the Internet (Sowe, SK; Kimata, T; Dong, MX; Zettsu, K, 2014). In that cyber-physical space, different type of sensors affect through the wireless network, collecting data and providing services for monitoring of

environmental pollution, management and recovery of disasters, improving of home life and enabling operation of smart cities. Usage of smart devices brings with it certain challenges like designing infrastructure to collect and store different types of product, finding practical application of collected data from sensors and management of IoT community so the end user can easily search, find and use the information. Authors propose IoT integrated architecture which combines functionality of Service-Controlled Networking (SCN) and cloud computing.

Big data is topic that is studied and will be studied for many years. Sets of data increase more and more, because they are collected with ubiquitous computing, mobile devices which read data, technologies of antenna sensors, remote reading data, logs of software, camera, microphone, RFID readers, wireless sensor networks (WSNs), etc. (Huang, Y; Ma, XQ ; Zhang, YD; Liu, YY, 2015). Big data has changed the way we collect and store data, enabling devices for data storing, architecture of data storage and mechanisms for data access. Cloud computing migrates application software and database on large centers of data, where data and service management may not be entirely reliable. Storage is one of problems that stop growth of Cloud. To solve the problem facing big data authors discuss about Cloud storage platform based on MapReduce for Big data.

Big data is concept of modern age that is used for processing large amounts of data from different fields medicine, remote monitoring, support services, etc. (Srivathsan, M; Arjun, KY, 2015). Prognostic computing is connected with Big data analytics and like a process, can require collecting, processing and analyzing extreme large amounts of structured and unstructured biomedical data, which comes from different experiments collected form hospitals, laboratories, pharmaceutical companies, and even social media. The results of predicting can improve efficiency in providing a better life for people.

In this paper authors give overview of background of Big data and overview on related technologies like Cloud computing, IoT, data centers and Hadoop (Chen, M; Mao, SW; Liu, YH, 2014), then focus on 4 phases of the chain value of Big data, generate data, acquisition, data warehouse and data analyses. Each phase is covered in detail along with description of the latest developments in these fields. At the end of paper authors describe several reprehensive application of big data including company management, IoT, social networks, media application, collective intelligence and smart networks.

Recently, water policy direction is changing from a typical plan for water usage and flood control to a sustainable water management, in order to improve quality of life (Kim, Yonsoo; Kang, Narae; Jung, Jaewon; Kim, Hung Soo; , 2016). These changes consist of information which is associated with water resources like data sets, management and supplying. All those resources are very important for deciding about water resource policy. Rae, Kang Na et al. have analyzed structured data according to type of usage. This study suggests an application of big data and cloud computing in field of water resources and usage of water. Data in this study are related to Korea and nearby countries.

3. MONITORING

Monitoring of the dams is important in process of dam management. Monitoring of dams is very important because it effects on dam operation and safety. If dam safety is disrupted, catastrophic consequence can happen for the people and surrounding eco-system. The process of dam monitoring includes significant number of sensors, which measurements are stored in database. In Serbia, system of monitoring dates to the tame when the dams were built.

Several dams (Djerdap I (Iron Gate I), Gruza …) started process of modernization of system for monitoring using new technologies and software (Lj. Petrović; S. Djurić, 2008).

Most dams use relational databases. Relational database can store limited set of data. Using new technologies like WSNs (wireless sensor networks) and intelligent sensors, amount of data is extremely increasing, which complicates the storage process and processing.

Data processing is also an important item for dam management safety. With data processing and simulation models, it is possible to predict the behavior of the dam and help in dam management.

On dams, there are different types of sensors which perform a variety of measurements. Some of sensors (instruments) are shown in next table.

Table 1: Measuring instruments

Measuring value	Measuring instrument
Pressure of groundwater	Piezometer with manometer Tele-piezometer
Relative movement of dam	Coordinometer Tele-coordinometer
Change of dam slope	Clinometer with vertical base Clinometer with horizontal base Tele-clinometer
Work of expansion joints	Deformeter
Air temperature	Thermometer for air

The following figure shows current mode of operation of piezometer, i.e. how piezometer collects data. Piezometer measures value and temporarily store data in Data taker in XML format and then acquisition server takes raw data and stores them in relational database. Central server takes data from acquisition server, validates data and store them also in relational database. End-users use utilities for taking data and analyze them and report on their computer.

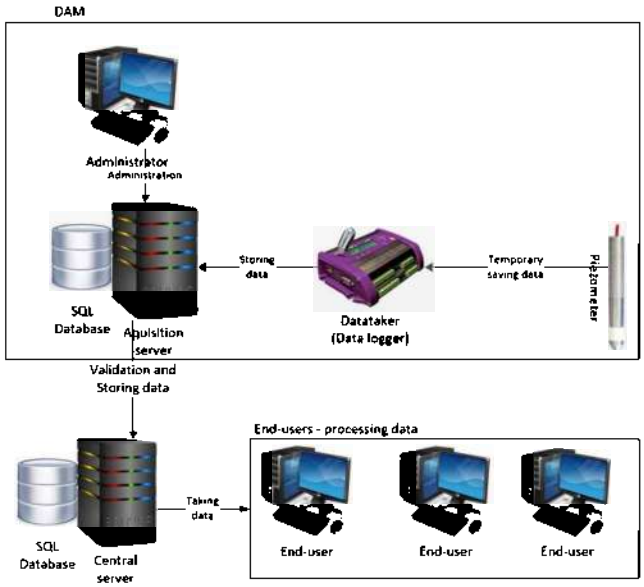


Figure 1: Monitoring on Large Dam

This way of collecting and processing data can work for databases which are smaller than 1TB and whose process doesn't require real time data process and use of current measured data. For processing large amounts of data and use of current measured data it is necessary to implement big data concept.

4. BIG DATA

There are "four V's" that characterize big data: Volume, Velocity, Variety and Veracity (Sathi, 2012).

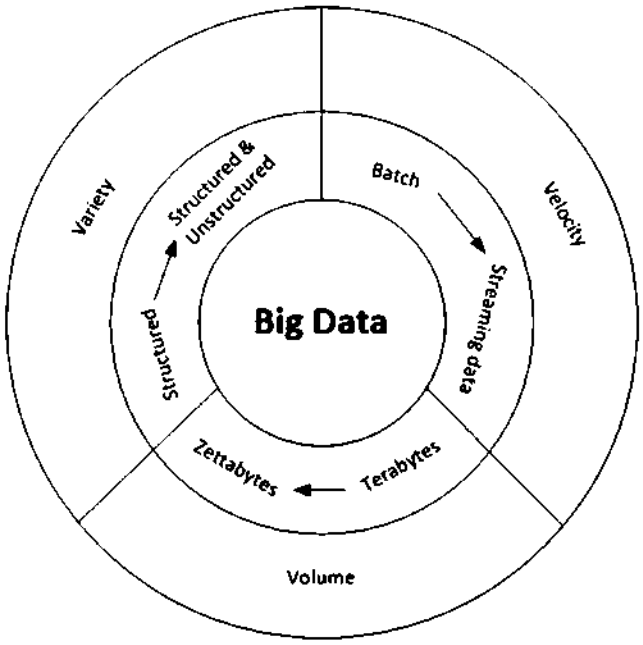


Figure 2: Big data (adopted from (Patel, 2013))

4.1 Volume

Most large companies are faced with the problem of increasing amounts of data. According to Fortune magazine, until 2003, 5 Exabyte of digital data was created. The same amount of data was created in 2 days

in 2001. For 2013 it was expected that this amount of data will be created in 10 minutes. In the past decade, organizations have had databases that are used for analytics and measured in terabytes. Today those organizations have databases measured in petabytes.

4.2 Velocity

There are two aspects related to the speed. One presents speed of data flow, and another latency.
The amount of global data that is transmitted through mobile devices rose up to 78% of total growth and is expected to reach 10/8 Exabyte per month in 2016, because users share more pictures and videos. To analyze this data, it is necessary to improve the infrastructure, which requires larger pipes and doing more parallel process.
Latency is the second measure of speed. Earlier, analytics operated on the principle of "store and data report" and makes reports with yesterday data. Today, analytics is included in business processes using fresh data with reduced latency.

4.3 Variety

In the last decade of 20th century, when the technology of Warehouse was rapidly introduced, the initial movement was to create Meta model which will represent all data in one standard format. Data was collecting from different sources and processing with the help of ETL (Extract, Load, and Transform) process. The basic idea was narrow range and structured content.
Bid data has greatly expanded the horizons, which allowed for new data integration and analytics technologies. Data sources contain unstructured text, sounds and videos as opposed to structured data. An example of enabling technologies is IBM's InfoSphere Streaming platform, which faces with various sources of real analytics and decision making, including medicine instruments for neonatal analyses, seismic data, CDR's, network events, RFID tags, patterns for traffic, time data, mainframe logs, voices on different languages and videos.

4.4 Veracity

Unlike the carefully ordered intern data, the most of big data comes from sources outside of control. Such data are not reliable and one is facing a defective and incorrect data. Veracity of data presents both credibility of data sources and similarity of the data for the target audience.

5. HADOOP

The Apache Hadoop software library is a framework that allows for the distributed processing of large data sets across clusters of computers using simple programming models (Hadoop Apache, 2016). It was made to scale up from single servers to thousands of machines. Local computation and storage can be made on each machine individually. Rather than rely on hardware to deliver high-availability, the library itself is designed to detect and handle failures at the application layer, so delivering a highly-available service on top of a cluster of computers, each of which may be prone to failures.

The project includes these modules:
- Hadoop Common: The common utilities that support the other Hadoop modules.
- Hadoop Distributed File System (HDFS™): A distributed file system that provides high-throughput access to application data.
- Hadoop YARN: A framework for job scheduling and cluster resource management.
- Hadoop MapReduce: A YARN-based system for parallel processing of large data sets.

Other Hadoop-related projects at Apache include:
- Ambari™: A web-based tool for provisioning, managing, and monitoring Apache Hadoop clusters which includes support for Hadoop HDFS, Hadoop MapReduce, Hive, HCatalog, HBase, ZooKeeper, Oozie, Pig and Sqoop. Ambari also provides a dashboard for viewing cluster health such as heat maps and ability to view MapReduce, Pig and Hive applications visually along with features to diagnose their performance characteristics in a user-friendly manner.
- Avro™: A data serialization system.
- Cassandra™: A scalable multi-master database with no single points of failure.
- Chukwa™: A data collection system for managing large distributed systems.
- HBase™: A scalable, distributed database that supports structured data storage for large tables.

- Hive™: A data warehouse infrastructure that provides data summarization and ad hoc querying.
- Mahout™: A Scalable machine learning and data mining library.
- Pig™: A high-level data-flow language and execution framework for parallel computation.
- Spark™: A fast and general compute engine for Hadoop data. Spark provides a simple and expressive programming model that supports a wide range of applications, including ETL, machine learning, stream processing, and graph computation.
- Tez™: A generalized data-flow programming framework, built on Hadoop YARN, which provides a powerful and flexible engine to execute an arbitrary DAG of tasks to process data for both batch and interactive use-cases. Tez is being adopted by Hive™, Pig™ and other frameworks in the Hadoop ecosystem, and also by other commercial software (e.g. ETL tools), to replace Hadoop™ MapReduce as the underlying execution engine.
- ZooKeeper™: A high-performance coordination service for distributed applications.

Next figure presents related technologies to Hadoop.

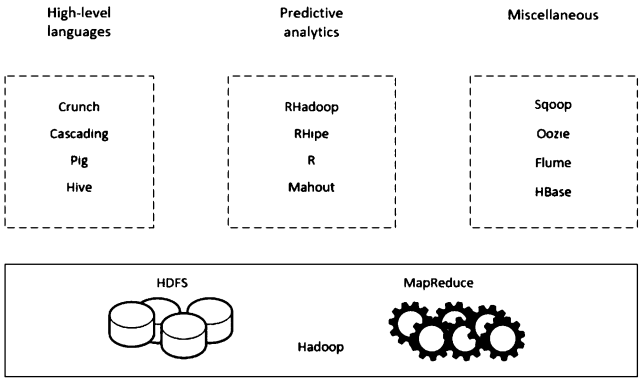


Figure 3: Hadoop related technologies (adopted from (Holmes, 2012))

Hadoop proper, as shown in Figure 4, is a distributed master-slave architecture that consists of the Hadoop Distributed File System (HDFS) for storage and Map-Reduce for computational capabilities. Traits intrinsic to Hadoop are data partitioning and parallel computation of large datasets. Computational capabilities scale and store with add in of hosts to a Hadoop cluster and can reach volume sizes in the petabytes on clusters with thousands of hosts (Holmes, 2012).

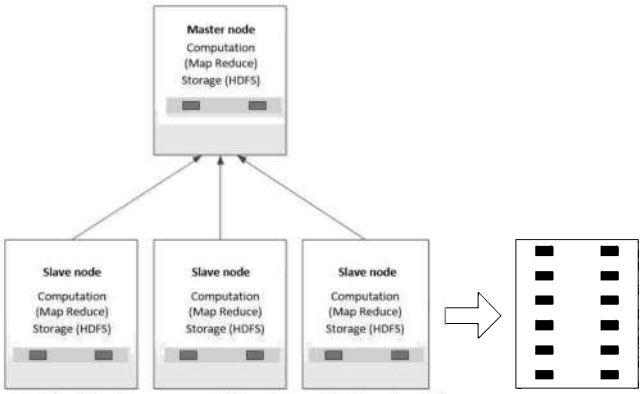


Figure 4: Hadoop architecture (adopted from (Holmes, 2012))

6. BIG DATA ON DAMS

Modernization of the instruments for monitoring requires the use of big data. Use of new, advanced and modern measuring instruments generates much larger amounts of data than the current situation, which can multiply size of database. Databases with hundreds of gigabytes will reach the size of over 1 terabyte. For processing these databases it is necessary to have computers with excellent performance, i.e. big process power. Implementation of Cloud concept would solve the problem of data processing.
Following figure shows suggestion of big data architecture on large dams.

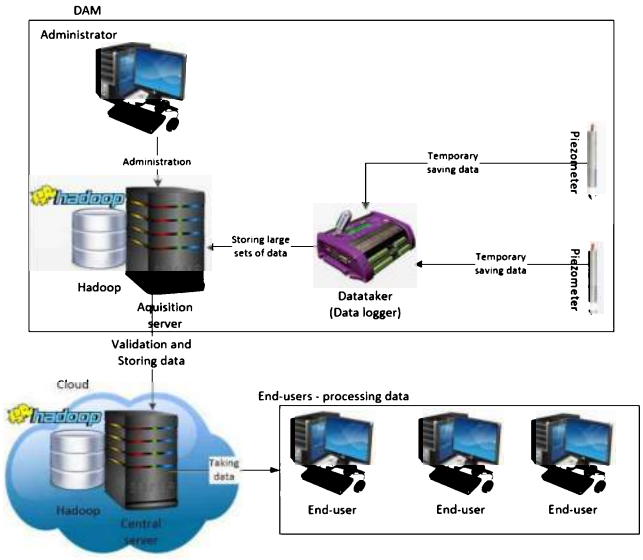


Figure 5: Hadoop integration in monitoring of dams

Process of collecting data is the same as before the implementation of big data. New process of monitoring is different because it uses big data concept and Cloud computing instead of relational databases. Use of Cloud computing allows the use of computer with better performance. Cloud enables faster data processing. Data processing in real time is of paramount importance for the prediction of the behavior of dams. Figure 5 shows measuring instrument Piezometer, which measures pressure of ground water. Measured data are temporarily recorded in data logger. From data logger, data are being transferred through computer network and stored in Hadoop database (HBase). The synchronization process is performed between Central and Acquisition server. End-user executes different tools (Mahout, Ambari, etc.) on Central server to analyze and utilize data in real time. Analyzed data will be used as input parameters for further simulation models of dam's behavior. In the case of natural disasters, such as floods, data processing in real time can help in the water resource management and reduce the possibility of damaging the dam to a minimum.

7. CONCLUSION

Dam monitoring is very important in dam management. Since dams in Serbia are old and of good quality, it is necessary just to improve the monitoring process.

Monitoring process can be improved by implementing new measuring instrument, which requires new approach in dam operating. Data process in real time and use of simulation models can predict dam behavior in some cases, which can lead to a more effective response in the event of natural disasters and save thousands of lives as well as the eco-system.
Use and application of big data concept improves process of dam management to a much higher level, increases dam safety, enables data process in real time and better prediction of dam behavior.

REFERENCES

Association of State Dam Safety Officials. (n.d.). Retrieved from http://www.damsafety.org/

B. Radenković, M. Despotović-Zrakić, Z. Bogdanović, D. Barać, A. Labus. (2015). *Elektronsko poslovanje.* Fakultet Organizacionih Nauka.

Big data. (n.d.). (IBM) Retrieved from http://www.ibm.com/big-data/us/en/

Chen, M; Mao, SW; Liu, YH. (2014). Big Data: A Survey. *Mobile networks & applications, 19*(2), 171-209.

Hadoop Apache. (2016). (The Apache Software Foundation) Retrieved from http://hadoop.apache.org

Holmes, A. (2012). *Hadoop in practice.* Shelter Island: Manning Publications Co.

Huang, Y; Ma, XQ ; Zhang, YD; Liu, YY. (2015). Study on Cloud Storage based on the MapReduce for Big Data. In *Proceedings of the 2015 international conference on mechatronics, electronic, industrial and control engineering*, Vol. 8, 1601-1605.

Kim, Yonsoo; Kang, Narae; Jung, Jaewon; Kim, Hung Soo; . (2016). A Review on the Management of Water Resources Information based on Big Data and Cloud Computing. *Journal of Wetlands Research, 18*(1), 100-112.

Lj. Petrović; S. Djurić. (2008). Osavremenjavanje sistema osmatranja na brani Gruža. *SDVB - Prvi kongres.* Bajina Bašta.

Patel, M. (2013). *Major League Baseball A Big Fan of EMC Big Data*. (EMC BIG DATA) Retrieved from http://bigdatablog.emc.com/2013/08/08/mlb-a-big-fan-of-big-data/

Rao, BBP ; Saluja, P; Sharma, N; Mittal, A ; Sharma, SV. (2012). Cloud Computing for Internet of Things & Sensing Based Applications. *6th International Conference on Sensing Technology (ICST)*, 374-380. Kolkata, INDIA.

Sathi, D. A. (2012). *Big Data Analytics: Disruptive Technologies for Changing the Game.*

Sowe, SK; Kimata, T; Dong, MX; Zettsu, K. (2014). Managing Heterogeneous Sensor Data on a Big Data Platform: IoT Services for Data-intensive Science. *38th Annual IEEE International Computer Software and Applications Conference (COMPSAC)*, 295-300. Vasteras, SWEDEN.

Srivathsan, M; Arjun, KY. (2015). Health Monitoring System by Prognotive Computing using Big Data Analytics., 602-609. Chennai, INDIA.

TRAFFIC FLOW WEB MONITORING BASED ON THE MONGODB

Stefan Zdravković*[1], Nikola Vulović[2], Ranka Stanković[2]
[1]Univerisity of Belgrade, Faculty of Transport and Traffic Engineering
[2]University of Belgrade, Faculty of Mining and Geology
* Corresponding author, e-mail: s.zdravkovic@sf.bg.ac.rs

Abstract: *Monitoring traffic flow is very important not only for monitoring purposes, but also for predicting possible causes of traffic accidents. Use of sensory devices allows easy data collection, but involves processing of large amounts of data, also called Big Data. Data query and statistical analysis are becoming less efficient with the growing amount of data. The aim of our paper is to present a new approach to data storing and processing in the traffic field. We collected data from automatic traffic counters (ATC) at ten checkpoints and stored it in a NoSQL MongoDB database. The main features of such database are flexibility, strength, speed and ease of use that have enabled us to create a reliable web application for monitoring traffic flow in real time. Applying this model, we were able to overcome the problems connected with rapid and efficient processing of collected data.*

Keywords*: Web application, MongoDB, NoSQL, Big Data, Traffic flow*

1. INTRODUCTION

Contemporary information and communication technologies and intelligent devices such as sensors provide traffic and transport systems, a steady inflow of enormous amounts of data. Intelligent transportation system (ITS) is a real-time, accurate and efficient integrated system for transport, traffic monitoring and management (Xiao et al., 2009). ITS have received much attention in recent years (Tarapiah & Atalla, 2015). Nowadays, the problem is not collecting data, but the difficulties in storing and processing of continuously increasing amounts of data. Big Data has been swiftly expanding into the transportation arena (Vlahogianni, Park, & Van Lint, 2015) and sensors are becoming ubiquitous (Aydin, Hallac, & Karakus, 2015). The enormity of Big Data is not confined only to velocity and volume, it is also reflected in the variability, variety, and complexity of the data. The velocity and volume of the data within traffic systems make it difficult for typical algorithms to scale and retain their real-time characteristics (Hayes & Capretz, 2015). The emergence of Big Data technology has changed the view of many scientific fields, including the field of transport (Shi & Abdel-Aty, 2015). It is expected that Big Data technology in traffic systems will make possible advanced behavior monitoring of the traffic system, identification and analysis of anomalies in its functioning (Hayes & Capetz, 2015), as well as automatic rerouting of traffic in case of congestion prediction, dynamic change of speed limits, detection of hazardous road conditions, more efficient processing of heterogeneous traffic accidents data and their consequences (Kumar & Toshniwal, 2015), construction of smart cities, faster reacting to damage to roads, etc.

In order to collect traffic data, automatic traffic counters are used (ATC). ATC devices measure relevant traffic parameters such as the number of vehicles, vehicle length, vehicle classes, vehicle speed, the lane in which the vehicle is moving. The model of ATC that we used, QLTC C-10, has a 1 GB SD card for data storage. Memory capacity enables the device to capture 1 (one) year of traffic data. After this period, the data is automatically overwritten. In addition, the device integrates a GSM / GPRS module, that connects one or more devices via the public network GSM 900/1800. It allows the user to monitor and collect traffic information from a distance. Traffic data and system information may be obtained remotely or manually using a PC and a GSM modem or automatically using a QLTCnet server. However, this device enables powerful and modern solutions for surveillance and traffic monitoring.

After data collection, the next thing that needs to be reliable in the application is certainly the database. Regardless of the application which is created for any device type, there must be an appropriate database. Applications store more and more data and access it at higher rates. However, the larger the amount of data, the slower the relational database operates. That is one of the reasons for the increased utilization of NoSQL databases in recent years (Khan & Mane, 2013). Generally speaking, a NoSQL database is one that uses a different approach to data storage and access when compared to relational database management systems (Lourenço et al., 2015). These databases provide the ability to store data in a single file so that multiple processors do not slow down operation of the database. Because of that, read and write functions operate more rapidly. NoSQL databases are used to solve two major problems: Big Data problem and searching

large amounts of data. As regards the type of data, MongoDB can incorporate any data while providing all the features needed to build any apps. If the database runs on a single server, it will reach a scaling limit. MongoDB scales adding more servers, and it was designed to work with commodity servers. MongoDB is relatively new in information systems which are not based on tables, schemes, SQL Query Language, or columns and rows. Likewise, transactions, ACID properties, joining functions do not exist in the MongoDB. The essential characteristics of the MongoDB are flexibility, strength, speed, and ease of use. For these reasons, we have decided to work with NoSQL MongoDB, which will enable us to handle the large amounts of data collected by automatic traffic counters.

The aim of our paper is to present a new approach to data storing and processing in the traffic field. The concept of the system is based on precise traffic counters, namely the QLTC-10C, and on modern telecommunications and information technologies, which enable reliable publishing of traffic data in real time on the web. First, we collected traffic data from ten measuring points, that are the result of traffic counts throughout 2015. The data generated by traffic counters are stored in textual (.txt) files. After that, we created a web application, which enables traffic flow monitoring and reporting on the state of traffic through automatic counter devices. With the appropriate technology, rapid and efficient processing of collected data is provided. The web app contains the main indicators of traffic flow and graphically displays data for the selected measuring point in the observed period. Some of these indicators are average daily traffic (ADT), annual average daily traffic (AADT) and monthly average daily traffic (MADT), as well as minimal speed, maximal speed, average speed of vehicles, etc.

2. TRAFFIC DATA AND IMPORTANT INDICATORS FOR MONITORING AND CONTROL

In the model that we propose, we decided to use the aforementioned automatic traffic counters. For each registered vehicle, ATC creates a record in the text file during the whole day (24 hours). An example of a text file generated by ATC is presented in Table 1. The first column shows the *Vehicle ID*, followed by *Date*, *Time*, *Channel* which takes a value of 0, 1, 2, 3 depending on the order in which the vehicle runs into the loop, *Lane*, which takes a value of 0 (vehicle in lane 1) or 1 (vehicle in lane 2), *Vehicle category* which refers to one of eleven vehicle classes, *Vehicle speed* in km/h and *Vehicle length* without correction factor measured in cm. At 10 measuring points during 2015, all ATCs generated 365 files, each file containing between 4.000 and 14.000 records, more than 35 million records in total.

Table 1: Daily data text file generated by ATC

Vehicle ID	Date	Time	Channel	Lane	Vehicle category	Vehicle speed [km/h]	Vehicle length[cm]
00001	01.01.15	00:04:30	0	0	A1	46	473
00002	01.01.15	00:05:16	0	0	A1	34	363
00003	01.01.15	00:06:19	0	0	A1	36	407
…	…	…	…	…	…	…	…
02467	01.01.15	23:58:15	0	0	A1	45	380
02468	01.01.15	23:58:23	0	0	A1	58	428
02469	01.01.15	23:58:28	0	0	A1	84	325

The following indicators are important for monitoring and traffic control that will be implemented in the web application: minimum vehicle speed, maximum vehicle speed, average vehicle speed for each measuring point, the total number of vehicles, average daily traffic (ADT), monthly average daily traffic (MADT), annual average daily traffic (AADT). Also, an overview of velocity distribution and a graphical overview of the total daily flow of traffic compared to the same period of the previous year will be enabled.

AADT estimation is fundamental to the analysis of transportation data sets and the management of transportation systems. AADT is used as an important basic data in the traffic and road sector (Ha & Oh, 2014). By monitoring these indicators, anomalies in the traffic system can be detected, and identification of factors that influence causing of traffic accidents on the observed road section can be made.

3. MODEL DESIGNED FOR MANAGING BIG DATA IN TRAFFIC

The total amount of collected data by automatic traffic counters is 15.4 GB. Due to a large amount of collected data that needs to be stored, as well as the speed of data processing, we decided to consider Hadoop Big Data platform and MongoDB database. It should be noted that if the data model is not flexible, it can slow down development.

Using the collected data, we considered which of these solutions is more appropriate for web application development. We chose MongoDB, which unlike Hadoop, is designed for real-time processing, and can also store a massive amount of data, while data processing at the time is performed on a small subset of data. Another advantage is processing time, which is measured in milliseconds.

QLTC-10C, the model of sensor that is used, can be equipped only with the unit solar cells (16 to 20 W), as can be seen in Figure 1 and the battery cell (12 Ah), which is sufficient for autonomous operation. It is designed for low voltage, with an electric power consumption at an integrated GSM / GPRS module of less than 120 mW.

The device is placed in a plastic roadside cabinet that protects the hardware against mechanical and atmospheric influences.

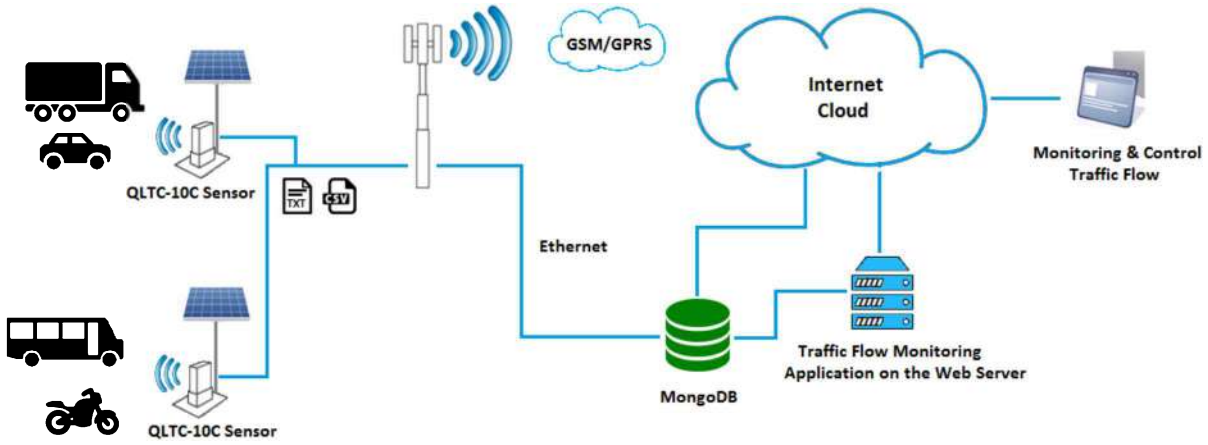


Figure 1: Model for managing Big Data in Traffic

By using the product software QLTCnet for a sensor device, it is possible to adjust the options that will execute transfer of the collected data in the required format. QLTCnet allows automatic transfer of data from remote locations using a public GSM / GPRS or private Ethernet network. Data is stored in a powerful NoSQL database. The database can be local, or it can be stored in the cloud.

Maintenance software enables fast handling of vehicle counters QLTC-10C. It allows configuration of device parameters, control of the device operation, data transmission in the standard .csv format. The device can be handled directly from the USB interface or remotely via a public GSM / GPRS network. The software consists of several modules. Each module is a standalone application that can be used separately from the other modules. Such an approach means that administration can be simplified since it requires less powerful laptops. Also, it allows faster loading of data, and enables easy adaptation to the specific needs of users.

The generated files are sent in the proper format .txt, .csv via the GSM / GPRS network or Ethernet to MongoDB as shown in Figure 1. Another key concept of MongoDB is that there must always be more than one copy of the database. If one database ceases to operate, the system will immediately take a copy from another server, and will continue to function normally. MongoDB uses JSON, XML or BSON, which is the binary-encoded serialization of JSON format to query and store data (Rupali & Aggarwal, 2013). It is important to note that MongoDB is not ideal for all types of problems. However, for many things, such as web application development, MongoDB is a great solution for the implementation of the database.

4. PROGRAMMING THE WEB APPLICATION AND MODEL IMPLEMENTATION

In this section, representative parts of the web application code, as well as its GUI will be shown. In the model implementation, we have used PHP language that is especially suited to web development and can be embedded into HTML.

Connection to the database.

```
function db_connection(){
                $conn_string = new MongoClient("mongodb://147.91.183.26:27017");
                $db = $conn_string->selectDB("traffic_db");
                return $db;
        }
```

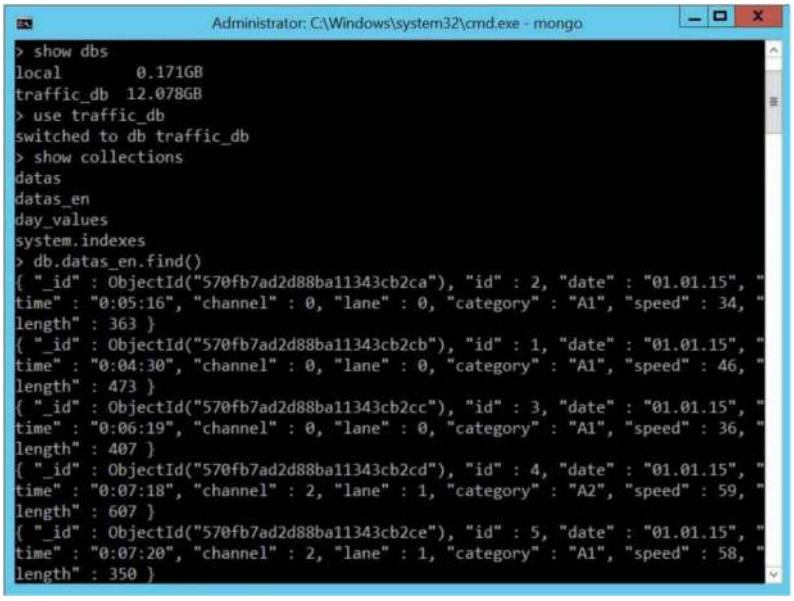


Figure 2: Review of collected data stored in MongoDB

Figure 2 shows traffic data collected by ATC. If we want to list all existing databases and chose the database that will be used, that can be done with the following code.

```
showdbs
use traffic_db
```

Two more lines of code, in order to show all collections and data respectively.

```
show collections
db.datas_en.find()
```

In order to use the web application, the user must log into the system. After the user successfully logs in, the startup screen appears as shown in Figure 3. At the top of the form, there is a menu that has three options: Data, Chart, and Exit. Data is related to the initial screen that the user can return to at any time. To view traffic indicators, the user enters the checkpoint parameters (selected from the combo box) and the period of observation. All checkpoints are loaded at startup form. In the fields for the observed period; the user must enter the start and the end date. Afterwards, he must check lane, at least one category of vehicles and an indicator such as a minimal speed, maximal speed, average speed, total number of vehicles, traffic volume. If the user checks velocity distribution or traffic flow, these indicators will be displayed in charts. By clicking on the submit button, the results will be shown on the right side of the same form as shown in Figure 4.

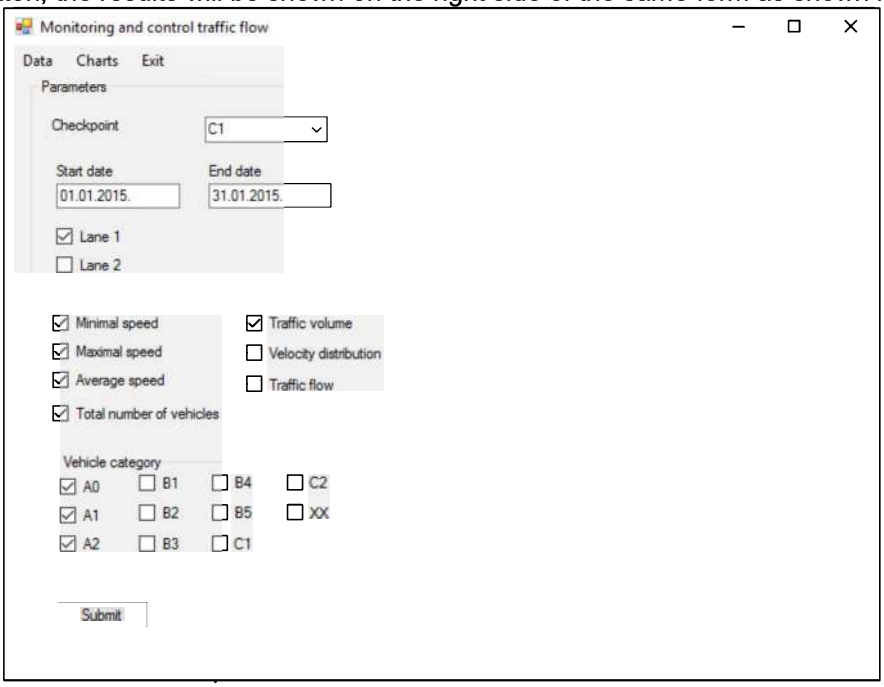


Figure 3: Startup screen of the web application

If the traffic volume is selected, parameters such as average daily traffic, monthly average daily traffic, and annual average daily traffic are shown as a group. These indicators are one of the essential for measuring air pollution (Jerrett et al., 2014).

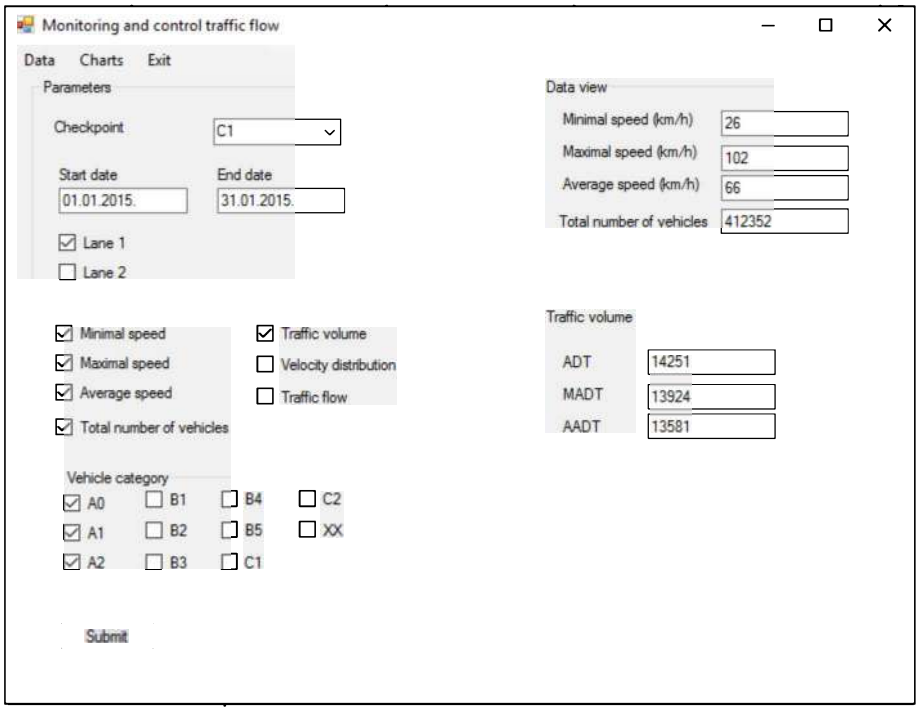


Figure 4: View of selected data

The user can easily change parameters within the same form and click on the submit button for a new view of the data. Displaying the charts is possible by selecting the velocity distribution and/or traffic flow within the parameters in Data window. The same chart view is enabled by selecting the menu item Charts from the top menu.

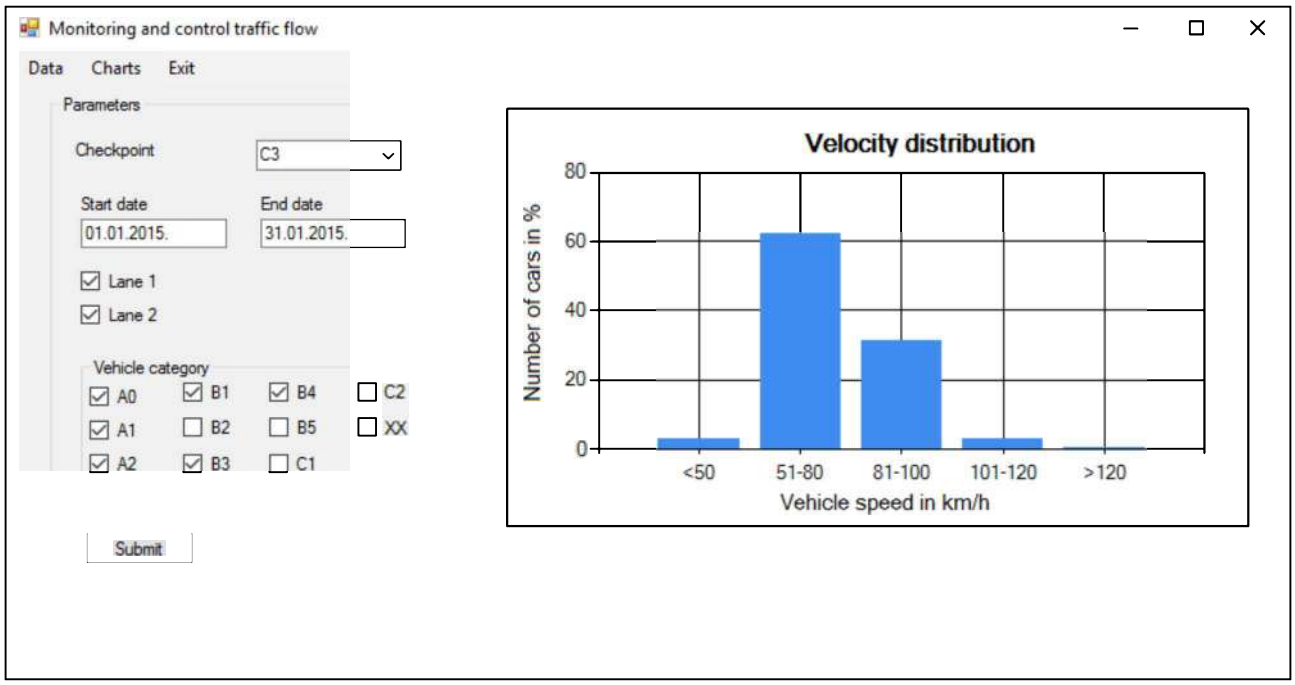


Figure 5: Chart of velocity distribution

Figure 5 shows a column chart for vehicle velocity distribution for the observed period, more specifically January 2015, checkpoint C3, lane 1 and lane 2, for categories of vehicles A0, A1, A2, B1, B3, and B4.

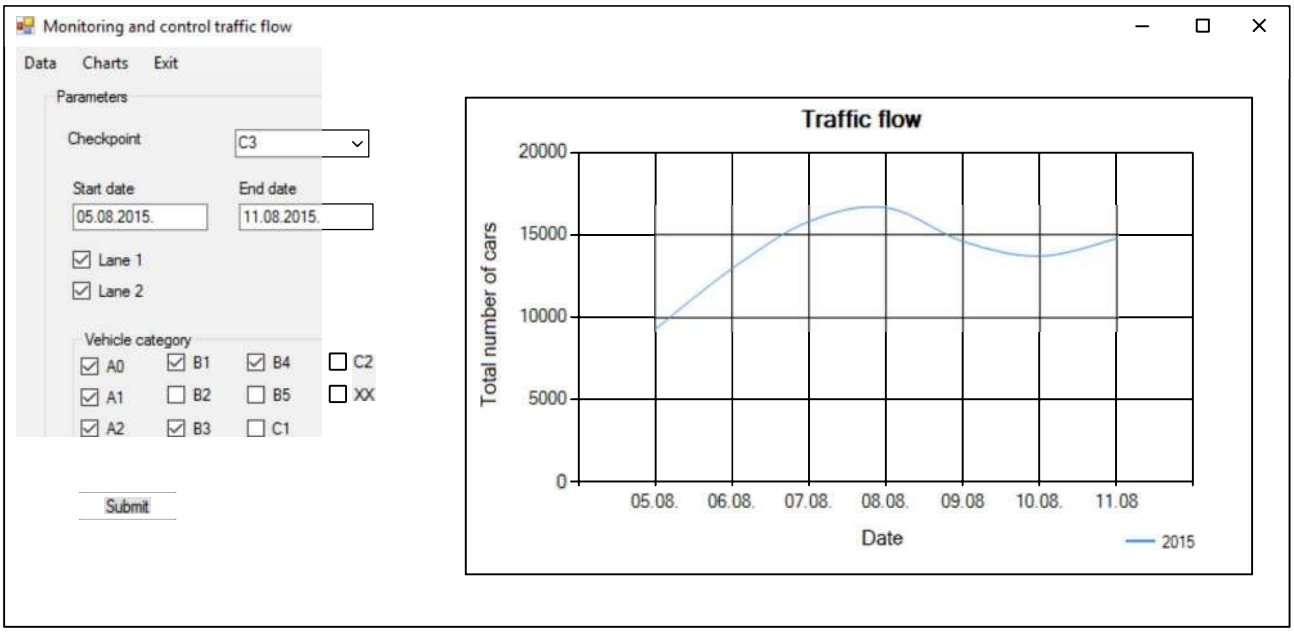


Figure 6: Chart of weekly traffic flow

The line chart shown in Figure 6. allows the user to monitor the daily traffic flow. The chosen observation period is the month of August 2015, when there can be more congestion due to vacations. The chart clearly shows that the highest number of vehicles occurred on August 8. This review of data is very convenient if we want to compare the traffic of the current year with that of the previous year. To end the work session, the user clicks on Exit in the top menu, and the application terminates.

5. CONCLUSION

Traffic is becoming one of important problems in our society (Cao, Li, & Zhang, 2011), which is possible to be resolved by the application of ITS and web monitoring. Web applications based on the use of sensory technologies place high demands regarding scalability, availability, and continuity that relational databases have difficulties in meeting. On the other hand, availability and scalability are two highly desirable properties pertaining to the reliability of a web application (Khan & Rao, 2014). A new trend in storing and processing of data is NoSQL open-source MongoDB database that is designed for very fast big data processing measured in milliseconds.

In this paper, we demonstrate the model for collecting and processing Big Data and develop a web application for traffic monitoring and control. As a result, we show that using MongoDB database as a data container and management with a web application represents an excellent solution that achieves high performances with large volumes of sensory data. The developed web application allows the user to monitor all significant traffic parameters such as average daily traffic, monthly average daily traffic, annual average daily traffic, the total number of vehicles, minimum, maximum, average vehicle speed. At any time, the user can observe any preferred checkpoint for an overview of the current state on the road and for predicting possible traffic jams. The reliability of the web app and high data processing speed is based on the NoSQL database.

The future research and development are directed to comparative analysis of traffic flow web monitoring implemented in relational and NoSQL databases. The presented model can be scaled to support a large number of traffic sensors as well as big data sizes. Moreover, it can be used to support further research in the application of Mongo database for real-time big data processing.

ACKNOWLEDGEMENT

The authors are grateful to the company MHM – Project, which provided the data generated by automatic traffic counters.

REFERENCES

Arora, R., & Aggarwal, R.R. (2013). Modeling and Querying Data in MongoDB. *International Journal of Scientific & Engineering Research, 4*(7), 141-144.

Aydin, G., Hallac, I.R., & Karakus, B. (2015). Architecture and Implementation of a Scalable Sensor Data Storage and Analysis System Using Cloud Computing and Big Data Technologies. *Journal of Sensors, 2015*, 1-11. doi:10.1155/2015/834217

Cao, Y., Li, W., & Zhang, J. (2011, October). Real-time traffic information collecting and monitoring system based on the internet of things. Paper presented at the *Pervasive Computing and Applications (ICPCA) 2011 6th International Conference on*, 45-49. doi:10.1109/ICPCA.2011.6106477

Ha, J.A., & Oh, J.S. (2014). Estimating Annual Average Daily Traffic Using Daily Adjustment Factor. *Journal of Emerging Trends in Computing and Information Sciences, 5*(7), 580-587.

Hayes, M.A., & Carpetz, M.A.M. (2015). Contextual anomaly detection framework for big sensor data. *Journal of Big Data, 2*(2), 1-22. doi:10.1186/s40537-014-0011-y

Jerrett, M., McConnell, R., Wolch, J., Chang, R., Lam, C., Dunton, G., Gilliland, F., Lurmann, F., Islam T., & Berhane, K. (2014). Traffic-related air pollution and obesity formation in children: a longitudinal, multilevel analysis. *Environmental Health, 13*(1), 1-10. doi:10.1186/1476-069X-13-49

Khan, S., & Mane, V. (2013). SQL Support over MongoDB using Metadata. *International Journal of Scientific and Research Publications, 3*(10), 1-5.

Khan, U., & Rao, T.V. (2014). Web Application's Reliability Improvement Through Architectural Patterns. *International Journal of Web & Semantic Technology, 5*(3), 1-16. doi:10.5121/ijwest.2014.5301

Kumar, S., & Toshniwal, D. (2015). A data mining framework to analyze road accident data. *Journal of Big Data, 2*(26), 1-18. doi:10.1186/s40537-015-0035-y

Lourenço, J.R., Cabral, B., Carreiro, P., Vieira, M., & Bernardino, J. (2015). Choosing the right NoSQL database for the job: a quality attribute evaluation. *Journal of Big Data, 2*(18), 1-26. doi:10.1186/s40537-015-0025-0

Shi, Q., & Adel-Aty, M. (2015). Big Data applications in real-time traffic operation and safety monitoring. *Transportation Research Part C: Emerging Technologies, 58*(B), 380-394. doi:10.1016/j.trc.2015.02.022

Tarapiah, S., & Atalla, S. (2015). Public transportation management system based on gps/wifi and open street maps. *International Journal of Advanced Computer Science and Applications*, *6*(1), 189–194. doi:10.14569/IJACSA.2015.060127

Vlahogianni, E.I., Park, B.B., & Van Lint, J.W.C. (2015). Big data in transportation and traffic engineering. *Transportation Research Part C: Emerging Technologies, 58,*161. doi:10.1016/j.trc.2015.08.006

Xiao, L., Peng, X., Wang, Z., Xu, B., & Hong, P. (2009, April). Research on Traffic Monitoring Network and its Traffic Flow Forecast and Congestion Control Model Based on Wireless Sensor Networks. Paper presented at the *2009 International Conference on Measuring Technology and Mechatronics Automation*, *2*, 142-147. doi:10.1109/ICMTMA.2009.405

THE POTENTIAL OF *BIG DATA* IN HEALTH SYSTEM

Marina Jovanovic Milenkovic*[1], Dejan Milenkovic[2], Aleksandra Vukmirovic[3]
[1]Faculty of Organizational Sciences, University of Belgrade
[2] Serbian Armed Forces General Staff
[3] Belgrade Business School Higher Education School for Applied Studies, Serbia
*Corresponding author, e-mail: marinaj@fon.bg.ac.rs

Abstract: *The paper gives an overview of the concept of big data and its significance in the health system. Big data is a new term that refers to the large amounts of data that are found in different forms and at different bases. Managing this data makes the entire business process more efficient and more effective, which is the case with the health care system. More specifically, applying of big data in the health care system leads to better health care to the exact diagnosis, more effective decision-making, better quality of work of health care institutions, etc. The paper points out that Big data in the health system has the potential to improve patient care, save lives and reduce healthcare costs. That potential in the health system lies in combining the traditional data with new forms of data at the individual level and at the population level.*

Keywords: *health system, big data in healthcare, Big Data Analytics, Volume, Variety, Velocity*

1. INTRODUCTION

The health system is now faced with a large amount of data. Given that we all strive to keep our health, it is necessary at every moment to have precise and accurate information (Jovanovic Milenkovic, Jeremic, Martic, 2014, Mr. Zhang, Ou Sh.X., Huang YH, Wang Ch.R., 2015). However, today in the health care system there could be found the large amounts of data that are not updated and that appear in different forms. The authors of the modern era have introduced a new term big data. Big Data in healthcare is being used to predict epidemics, cure disease, improve quality of life and avoid preventable deaths. The drive now is to understand as much about a patient as possible, as early in their life as possible – hopefully picking up warning signs of serious illness at an early enough stage so that treatment is simpler and less expensive (Forbes, 2015). For the patient it will mean better, quicker and cheaper diagnosis and treatment, and better information about health care providers. In the following section of this paper it will be explained what *Big data* is and what is the potentional big data in health system.

LITERATURE REVIEW

Digital healthcare solutions have promised to transform the whole healthcare process to become more efficient, less expensive and higher quality (Liu, Park, 2014). Modern business indicates that all health data should be in electronic form. Electronic health system (eHealth) is allowed to be easier and faster access to such data.

But in some case, electronic health data is unavailable, inadequate, or unusable. The healthcare databases not link all data. Other challenges related to big data include: the exclusion of patients from the decision making process, and the use of data from different readily available sensors (Gaitho M, 2015).

Development and improvement of Big Data Technologies has opened up a gateway to its introduction in e-health, and also is becoming increasingly urgent to initiate its integration, as, simultaneously, other technologies are being developed to solve many of the problems in the sector (as tele-monitoring, tracing and labeling of patients, staff, drugs, equipment, etc..) that will be generating even more data (Díaz, Juan, Lucas, Ryuga, 2012).

In the healthcare of the future, it is necessary to manage more and better, both patients and supplies, whether internal or external. Furthermore, the use of Big Data technologies together with concepts such as Health Cloud will allow to change the data structure of the sector, focused on health centers or institutions, into one more focused on patients as individuals with a track record that are attended by centers in a time stamp. One of the strong points of the Big Data is that there are various specifications, which can be adapted to the particular needs of the different fields of the e-health, to give very specific and efficient solutions (Díaz, Juan, Lucas, Ryuga, 2012).

2. BIG DATA

What is *Big data*? Although in literal translation it means "a large amount of data," Big Data is a complex phenomenon (Vukmirović, Vukmirović, Jovanović Milenković, Vukmirović, Brbaklić Tepavac, 2016). Today there are many definitions. One of them is from the report which was submitted to the US Congress in 2012 that defines Big Data as "large amounts of data, high-speed, complex and variable data that require advanced techniques and technologies to enable the capture, storage, distribution, management and analysis of that information".

According to another definition, *Big data* is a set of techniques and technologies that require new forms of integration in order to detect hidden large data values (Abaker, Hashem, Yaqoob, Anuar, Mokhtar, Gani, Khan, 2015).

The term *Big data* should not to be identified only with the large amounts of diverse data, but with the techniques used in the processing of these data and the ways of making conclusions and important business decisions based on that. Due to this characteristic the more often used term is Big Data Analytics or "analytics of the large amounts of data," as its purpose is that by the application of advanced technology and statistical techniques finds the hidden patterns in data and generate information for making important business decisions (Chawla, Davis, 2013).

Big data is based on three basic dimensions that make up the "3V concept'': Volume, Variety, Velocity (McAfee, Brynjolfsson, Davenport, Patil, Barton, 2012).

- Volume – high speed of growth in volumes of new data and storage of the existing data leads to the situation that hundreds of terabytes or even more are now stored. According to IBM, 90% of the data that exist today have been created in the last two years. On the other hand, according to the McKinsey Global Institute, it is expected that the amount of data generated globally to grow at an average annual rate of 41% and that in the period from 2008 to 2020, this amount will increase by 44 times, from 0-8 zettabytes in 2008 to 35 zettabytes in 2020. The best indicator about the quantity of data is the fact that every day on Facebook generates 10 and Twitter 7 terabytes of data (McKinsey Global Institute, 2011).
- Variety - is no longer enough to keep only structured data, but also images, data from social networks, logos, sensor data ... Thus there are the following data (Ronk, 2014, Syed, Gillela, Venugopal, 2013):
    1. Unstructured data – the data by which the classical arithmetic operations can not be performed, account for over 80% of the data. These are the various data such as audio files, video files, text files, etc..
    2. Semi-structured data - make up about 10% of the data. These are mostly data that can easily be transformed into the form suitable for the performance of conventional arithmetic operations, such as, for example, information obtained through the Web analytics.
    3. Structured data - make up only 10% of the data. These are data that are created by using a variety of analytical tools such as business analytics, databases, etc.
- Velocity – the new data are generated at high speed, which is far greater than the speed of data processing. For example, within one minute in the world (Al-Taie, 2016):
    1. over 3,500 transactions on stock exchanges are performed,
    2. over $ 3 million is spent on online shopping,
    3. over 200 million e-mails are sent,
    4. over 2 million searches on Google (3.5 billion daily)
    5. over 700 thousand new content are published on Facebook
    6. over 400 thousand on Twitter,
    7. over 600 new video content on YouTube,
    8. over 400,000 minutes of talking on Skype and
    9. over 1,500 blog posts are published.

To these three dimensions some authors add other dimensions, creating an expanded concept of Big Data. Some authors add the dimension of reliability data (Veracity), making the "4V concept", while on the other hand, some authors add another dimension and value (Value) and effectiveness (Viscosity), making extended "6V concept".

Most researchers concerned with the traditional methods of research suggest the following (Mishkin & Hodson, 2014):

- Traditional research reveals why customers feel the way they do. Big data reveals what customers do.
- Big data can tell you a lot about people: When they do it, What they do, Who they are doing it with, Where they are doing it but it can't tell you why.

3. *BIG DATA* IN THE HEALTH SYSTEM

3.1. The types of data

Most of the data is useless from the standpoint of quality and timeliness, but their availability is the imperative that makes the companies to: find the right data (Big Data), save them (Cloud), process them (Map Reduce) and finally analyze them (Data Scientists) in real time. The time factor plays a key role because today's users are very well connected (online) and informed (social media) and communicate with each other in real time (smart phones, tablets) (Vukmirovic, Vukmirovic, Jovanović Milenkovic, Vukmirovic, Brbaklić Tepavac, 2016).

As abovementioned, in the healthcare there are large amounts of data that are kept for one patient. The volume of health data is expected to increase dramatically in the coming years. Data are increasing with 80% of unstructured medical data.

A lot of these data are in paper form with the trend towards the digitization of these data. These data are of different structures and are located in different databases. The data is located in different places in the patient records, in the form of laboratory data, notes, doctor ... The basic characteristic is that data are becoming more and more "unstructured" (Vukmirovic, 2015):

- Texts,
- Audio,
- Video,
- Images,
- Geospatial and
- Internet data (*slick streams, log* files).

Big data in the health care system is becoming dominant, not only because of the size of data but also because of the diversity of types of data and the speed which must be managed. The health care industry needs to identify and establish proven strategies and best practices for big data management data. The totality of the data related to the health care of patients includes:

- Clinical data, systems for decision support, written notes of doctors and prescriptions, medical imaging, laboratory data, insurance data and other administrative data;
- Data on patients in an electronic patient file;
- Monitoring the data on social networks, including Twitter (aka. Tweets), blogs, Facebook and other platforms;
- Web pages where you can find information, news and articles in medical journals.

From the above we can conclude that the sources and types of data can be found at (Raghupathi, Raghupathi, 2014):

- *Web* and on social media: Interaction on *Facebook, Twitter, LinkedIn*, blogs, etc.
- Loading data by using the devices;
- *Big data* transaction: The institutions that have the transactions perform with semi-structured and unstructured data;
- Biometric data: fingerprints, genetics, handwriting, blood pressure, medical imaging and other similar types of data;
- Human-generated data: unstructured and semi-structured data, such as electronic patient record, physician's notes, *e-mail*, paper documents...

3.2. The potential of big data in health system

Collecting all the information from those sources creates the access to monitoring the health status of an individual or the entire population. However, different stakeholders have different goals and hopes for Big data and its analysis:

- Patients - want daily use of new technologies in order to get better care with the correct diagnosis;
- Providers – the access to the patient data by the clinics in order to improve decision making, achieving efficiency in the work without error;
- The researchers - want a new tool to improve the quality and quantity of the work flow. These include the various statistical tools, algorithms;
- Pharmaceutical companies - they want to better understand the causes of disease and thus get the safer drug market;

- Companies for the production of mobile devices – integrate the users data with the data they can collect about them via the data collected by using mobile devices;
- Governments – are trying to reduce the costs, introduce the regulations;
- Software development companies - see opportunities to serve the wholesale market, to develop software that will find its application in the health system.

Big data has the potential to improve patient care, save lives and reduce healthcare costs. The potential in health system lies in combining the traditional details with new forms of data at the individual level and at the population level. In Table 1 we can see the differences between traditional analytics and Big Data analytics in relation to data sources, processing techniques, intensity, time and purpose of data processing.

Table 1: Traditional analytics vs. *Big data* analytics (Lazarević, 2015)

Parameter	Traditional analytics	*Big data* analytics
Volume of data	The analysis of the part of data (*Partial Data*)	The analysis of all data (*All Data*)
Sources	A small number of homogeneous data sources	A large number of heterogeneous data sources
Data processing techniques	Standard tools and techniques (classic software, classical statistical techniques)	Advanced tools and techniques (advanced software, advanced statistical techniques)
Data processing time	After generating the data (Ex-Post)	In the course of generating the data (Real-Time)
Data processing intensity	Occasional data processing (Ad-Hoc)	Continuous data processing
The aims of data processing	Diagnosis and description of the event	Behavioral analysis and forecasting of events
The types of reports	Standard uniform reports	Complex reports

Therefore, all these data should be aggregated into a single integrated system that will contribute to an efficient and well managed health data in order to help doctors be able to timely and accurately provide health services to each patient. The components and architecture of *big data* in the health system are shown in Figure 1.

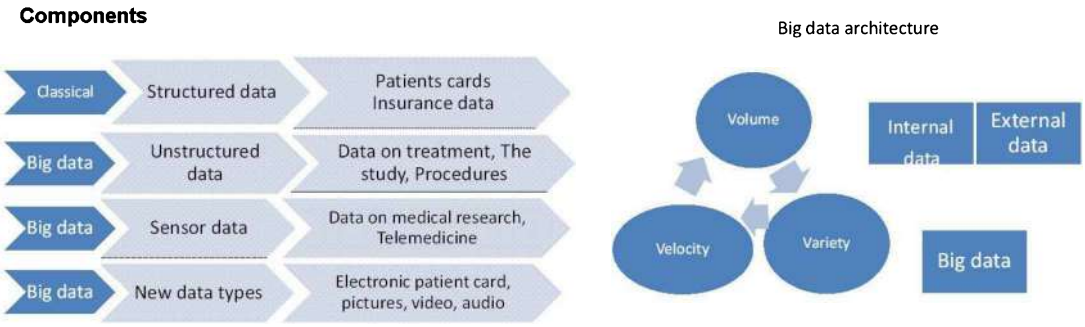


Figure 1: The components and architecture of *big* data in the health system

The *open source* platforms like Hadoop/MapReduce, available on the cloud, encourage the use of big data in the health sector. Fortunately, the advances in data management, especially virtualization and cloud computing, facilitate the development of platforms for the efficient capture, storage and manipulation of large amounts of data.

MapReduce is designed by Google as a model of efficient execution of a set of features over a large amount of data in *batch* mode. The first component of this solution is the "Map" component. Its function is to distribute the problem of programming or task that inevitably occur due to excessive number of data in the system, and manages the set tasks in a way that balances the load, as well as to manage the process of recovering from mistakes. After the process of distributed calculation is completed, the second function of this solution gets activated which is titled "reduce" that connects all the elements together again, in order to provide the results (Figure 2) (Vukmirovic, 2015).

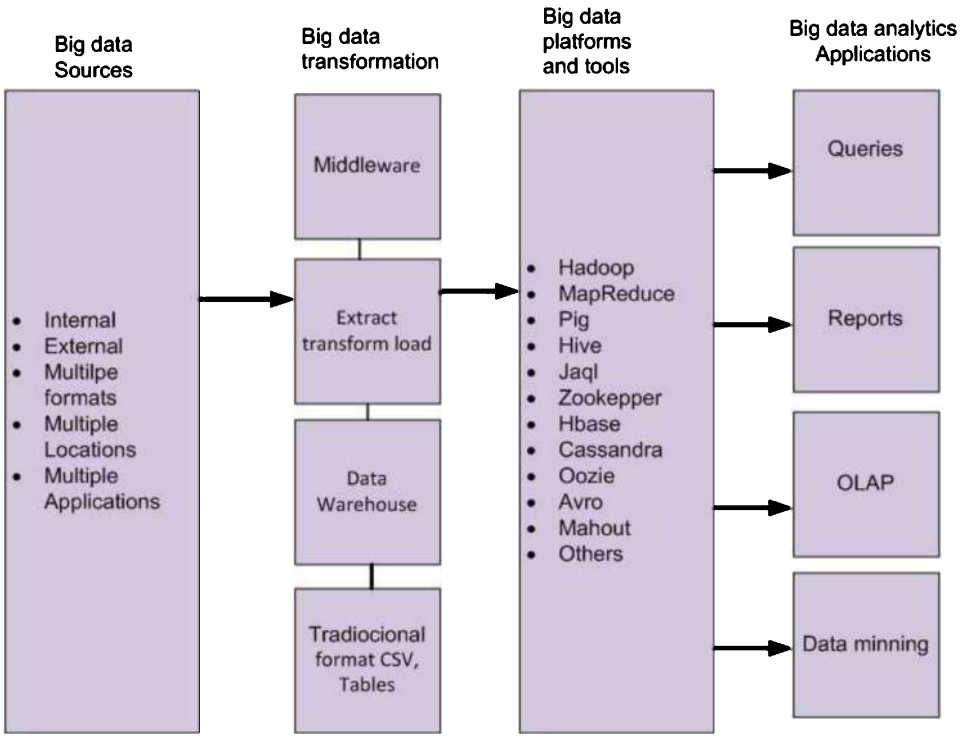


Figure 2: The conceptual model of *Big data* (Raghupathi, Raghupathi, 2014)

By using *Big data* databases the medical institutions may save the money, increase revenue and realize a multitude of business goals:

- Developing of new applications. *Big data* enables the organizations to collect real-time billions of data related to their products, resources and users, as well as on the basis of these data immediately optimizes the user experience and the use of resources.
- Improvements in efficiency and cost reduction of existing applications. *Big data* technologies are generally "open source" that can be used, exchanged and modified by everybody. Therefore the implementation and use of Big Data technologies is much cheaper compared to the development of proprietary technologies..
- The outputs of new sources of competitive advantage. Big data allows the organizations to quickly adapt to changes in relation to its competitors. For example. MongoDB platform has enabled one of the largest providers of support for human capital management to develop in record time a mobile application that integrates data collected from multiple unrelated sources.
- Increase customer loyalty. Increasing the amount of data exchanged within the institution and the speed at which they are updated allows the organizations to quickly and accurately respond to user demands.

4. CONCLUSION

Big data in the health system has the potential to transform the way and to contribute to health care workers use sophisticated technology on the basis of which they will be able to make better decisions in health care. *Big data* and applications in healthcare are emerging development, but the rapid progress in the platform and tools can speed up the ripening process of work and contribute to better decision-making in health care. This will bring the more accurate diagnosis of patients. In this way the efficiency and effectiveness in the implementation of big data in the health system are achieved.
A lot of health data are in paper form with the trend towards the digitization of these data. These data are of different structures and are located in different databases. The data is located in different places in the patient records, in the form of laboratory data, notes, doctor ... The basic characteristic is that data are becoming more and more "unstructured".

Big data in the health care system is becoming dominant, not only because of the size of data but also because of the diversity of types of data and the speed which must be managed. The health care industry needs to identify and establish proven strategies and best practices for big data management data. The totality of the data related to the health care of patients includes: clinical data, systems for decision support, written notes of doctors and prescriptions, medical imaging, laboratory data,

insurance data and other administrative data; data on patients in an electronic patient file; monitoring the data on social networks, including Twitter (aka. Tweets), blogs, Facebook and other platforms; Web pages where you can find information, news and articles in medical journals.

Big data has the potential to improve patient care, save lives and reduce healthcare costs.

REFERENCES

Abaker I., Hashem T., Yaqoob I., Anuar N.B., Mokhtar S., Gani A. & Khan S.U., (2015), The rise of "big data" on cloud computing: Review and open research issues, Information Systems, 47, 98-115. ISSN 0306-4379, http://dx.doi.org/10.1016/j.is.2014.07.006

Al-Taie M. Z. (2016), Social media with big data analytics, Big data centre Universiti Teknologi Malaysia, Retrieved from http://www.slideshare.net/MohammedTaie/social-media-with-big-data-analytics

Chawla N.V. & Davis D. A.(2013), Bringing Big Data to Personalized Healthcare: A Patient-Centered Framework, Journal of General Internal Medicine 28(3), 660-665.

Díaz M., Juan G., Lucas O. & Ryuga A., (2012), Big Data on the Internet of Things: An Example for the E-health", IMIS, Innovative Mobile and Internet Services in Ubiquitous Computing, Paper presented at the International Conference on 2012, 898-900.

Forbes (2015), How Big Data Is Changing Healthcare, Retrieved from http://www.forbes.com/sites/bernardmarr/2015/04/21/how-big-data-is-changing-heal

Gaitho M, (2015), How Applications of Big Data Drive Industries, Big Data and Analytics Articles, Retrieved from http://www.simplilearn.com/big-data-applications-in-industries-article

Jovanovic Milenkovic M., Jeremic V. & Martic M., (2014) *Sustainable Development in the e-Health Sector of the European Union,* Journal of Environmental Protection and Ecology, 15(1), 248-256.

Lazarević I., (2015), Big data u farmaciji i medicini, BB Informator, 242.

Liu W. & Park E.K., (2014), Big Data as an e-Health Service, Computing, Networking and Communications (ICNC), Paper presented at the *2014 International Conference on, Honolulu*, HI, 982 – 988.

McAfee, A., Brynjolfsson, E., Davenport, T. H., Patil, D. J., & Barton, D. (2012). Big data. The management revolution. *Harvard Bus Rev*, 90(10), 61-67.

McKinsey Global Institute, (2011), Big data: The next frontier for innovation, competition, and productivity, retrieved from http://www.mckinsey.com/business-functions/business-technology/our-insights/big-data-the-next-frontier-for-innovation

Mishkin G., & Hodson D. (2014) *Traditional Market Research and Big Data Integration*, AT&T Mobility & Market Strategies International, Retrieved from http://www.insightinnovation.org/

Raghupathi W. & Raghupathi V., (2014), Big data analytics in healthcare: promise and Potential, Health Information Science and Systems, 2(3)

Ronk J., (2014), Structured, semi structured and unstructured data, Bid data, EAI, Retrieved from https://jeremyronk.wordpress.com/2014/09/01/structured-semi-structured-and-unstructured-data/

Syed A. R., Gillela K. & Venugopal C. (2013), The Future Revolution on Big Data, *International Journal of Advanced Research in Computer and Communication Engineering*, 2(6).

Vukmirović A., (2015), Model infrastrukture za internet marketing istraživanja u elektronskom poslovanju, pristupni rad, Fakultet organizacionih nauka, Beograd

Vukmirović D., Vukmirović J., Jovanović Milenković M., Vukmirović A. & Brbaklić Tepavac M., (2016), Big Data and marketing research, 35th International Conference on Organizational Science Development, Portorož, Slovenia, ISBN 978-961-232-286-1

Zhang G., Ou Sh.X., Huang Y.H. & Wang Ch.R., (2015), Semi-supervised learning methods for large scale healthcare data analysis, International Journal of Computers in Healthcare 2(2), 98-110.

IMPROVING E-COMMERCE SYSTEMS WITH BIG DATA TECHNOLOGY

Nenad Stojić*, Aleksandra Dacić-Pilčević
University of Belgrade, Faculty of Organizational Sciences
*Corresponding author, e-mail: neshcko@gmail.com

Abstract: *This paper presents one of the aspects of using Big Data technology in e-commerce systems. The main goal of this document is to present a solution of how a non-relation database can be integrated to e-commerce platform. Mongo database is used, as a Big data storage solution, to improve data scalability and search performance with enormous amount of products data on Magento platform. The first part of this document describe Big data technology and present a Magento platform. In this document also is presented a solution model of how big data technologies works on practical application in real electronic store. Document will be analyzed problems of electronic store which related to search and analytics of products data. Results can help another e-commerce systems to improve their services and continue to work on further technology improvements.*

Keywords*: Big Data, Magento, Mongo DB, Non-relation DB, E-commerce*

1. INTRODUCTION

With a grater amount of data comes a bigger problems, therefore, the more data the company holds, it is going to be harder to manage them, from the perspective of keeping the data and form the perspective of analyzing the same. Big data is designed to offer to companies a huge business insight. Today, the available amount of data reach units of petabytes and exabytes where traditional architecture and infrastructure simply don't gives a good results.

These days, in hyper-competitive business environment, companies do not need only to find and analyze a particular data, they also must do it as soon as possible. In the last few years, as a results of the expansion of electronic stores and e-commerce as a whole, there was a need for better application quality development and optimal use of technology to achieve a better results. Big data in e-commerce has received a special attention and provoked many questions which are opened the door for the future business opportunities.

2. BIG DATA TERM

Big data comes with their dimensions. Different authors emphasizes different dimensions, but common elements are: Volume, Variety and Velocity and they will be explained in this research, but before continue with dimensions it's important to mention a couple of facts that are characteristic for Big data.

When is talking about big data and a huge data information, it is necessary to point out a few facts:

- Big data are ideal for the analysis of both, structured and non-structured data, which come from a different sources.
- It help us in situations where the traditional relation databases are unusable.
- It will manage data better.
- Benefit from speed, capacity and scalability of cloud storage.
- Data analysis methods, capabilities will evolve.

Volume: Differences of storage have changed through time, year by year, and today are reached the size of zettabyte. Beside the growth in size there comes to a decline in price of memory. The expected growth of memory is a huge and with this information we get the fact that someone must analyze this amount of data. All this does not mean that scientists or analysts have problem to store the data, this indicates more to possible problem in the analysis of these data, where the Big Data technology simply can help.

Variety: Special attention relates to the diversity of the analyzed data. We have structured data stored in databases and semi-structured and unstructured data which makes the most of it and which we concerned. This is not suggest that unstructured data don't have a structure, it's about their subcomponents do not have the structure by default (comments, pictures…). It's important to focus on all the data and with their combination increase the value. In fact, the example of this can be found in e-commerce solution. The companies all the

time receive the calls from customers, which represent an unstructured data, and they can combine them with structure data (orders, transactions and so on) and from this we get personalized model of customer, which represent combination of structured and unstructured data.

Velocity: The Velocity, actually is the speed of creating, storing, analyzing and visualizing the data. Big data allows a real time, work with orders, products and customers even better. There was a time when the users just used information from day earlier, similar to newspapers, where information was collected and analyzed for the next day. Today, with new technology and availability of large number of services, user just won't wait even the few seconds and everything after that is considered as old data. Products that we present on our service must be analyzed and presented to the right buyer in real time, this high velocity data, represent big data.

3. NON-RELATION DATABASE

In recent years, NoSQL or non-relational databases have gained great popularity in terms of storing large amounts of data and their ease of expanding. There is debate about whether the non-relation database in the future will replace the relational databases. With the increasing number of social and other unstructured data, the following questions began slowly but surely to be placed over relational databases.

- Are the relational databases able to cope with large amounts of data (Big Data)?
- Are the relational databases is able to reduce the large amount of data?
- Are the relational databases suitable for the modern era of data?

The technology which used for big data storage are non-relation databases. For this document research we used Mongo database engine as database system based on non-relation database technology.

3.1. Mongo Database

One of the most well-know open source of NoSQL databases is Mongo database. It's design by company 10Gen, written in C++. Query language is written in JavaScript and reminiscent on SQL. It's licensed by GNU Affero GPL license and from popular company used by Foursquare, SAP, Github and others.

Indexing: It allows a high performance of operation executing on most used queries. Mongo database index represents the structure of data which allows very effective document positioning based on particular value in fields of document.

Aggregation: Mongo database provides a function aggregate() which is used for data aggregation and it used on particular collection. It also using additional operators: sort (document sort), skip (ignoring the particular number of document on start of collection), match (document filtering based by value of field), group (document grouping), project (defined fields from the document, which will be included in the result) and unwind (transforms a string).

Replication: This mechanism allows data synchronization between more Mongo database instances. There is just one primary instance and all others are secondary. Replication must to provide redundancy, increase availability and facilitate some administrative tasks such as backup. Mongo database provides a mechanism where if crash the primary instance, with the mechanism of votes it select the new primary instance.

Auto-sharing: This mechanism allows participations collection of documents and their distribution to larger number of instances. The idea of this mechanism is to improve a capacity of the system.

Map Reduce: Allows parallel processing of large amounts of data.

Ad-hoc query: Dynamic (ad hoc) queries allow working with Mongo database infection in a similar way as to RDBMS. Therefore, this feature is ideal when switching from RDBMS system on Mongo database.

GridFS mechanism: This mechanism allow storage of large documents. In particular, MongoDB can work with the document size of 16MB. Because of this limitation, GridFS mechanism is used as mechanism which separate document into series of pieces. For storing the large documents there are use two collections: collection of 'files' which represents a meta data of document and collection of 'chunks' which contains parts of document. Size of the parts of a document is usually 256 KB.

Mongo database offers very good performance for situations that containing very high write loads, but where data integrity isn't a pressing concern; a good example are the comments sections of large, busy websites like Craigslist or The New York Times, both of these use Mongo database.

4. SOFTWARE SOLUTION FOR THE IMPLEMENTATION OF ELECTRONIC STORE

E-commerce represents a business model that allows management business via the internet and with using applications that are located on the internet. Online business is a clear advantage because it is available all the time and provides efficient service to customers.
One of the most important parts of an e-commerce portal is the fact that you can explore a large number of products and services, consider their fully purposes and view the price without physical presence in stores. Today, users want to be able for ease use and access to systems, where they can finish the shopping by a few clicks. This fact will completely change the approach to trade and allow purchases anywhere and at any moment through different devices.

Magento represents a very powerful and flexible e-commerce platform that is now one of the most developed and fastest growing platform in the world of e-commerce solutions. Magento is an e-commerce platform that allows employers to the various modules that are flexible, which have dynamic content, and which the seller can control and adapt to their needs. It represents an open source technology that has strong marketing tools, which support the search and optimization to meet and adapts to any type of business. It is vary scalable and widely available platform because of its stability and flexible nature.

Magento is e-commerce CMS platform is based on a PHP/MySQL structuring and relying on a Zend framework. With Magento, customers are able to completely manage their online store, display specific product and provide customers various payment methods and shipping, and many other options.

Magento benefits:

- Open source platform
  It represents an open source system which is available on the Internet. As such, the system allows developers access to the core of the system and allows the use of new functionality through its extensions.
- Easier way of content management
  Magento has functionality that can allow a management of more stores under the same platform. It also supports multiple sites management that are the part of a particular store. The main functionality is reflected in the use of the common Admin panel for the overall management. All sales may be administered through a single base. With their flexible contain management system, Magento is very useful for those who want to sale 10 products or a 10 million products. In the moments when sales grow dramatically, with the help of Magento you can more easily manage the sales process so that in the event of an increase in sales and profits.
- Scalable platform
  Magento is a flexible platform. It's available for both, small and large companies. It can be adapted depending on the business and the complexity of the requests. As a scalable and flexible system, with its customization they can be delivered to any business model.
- User friendly
  Introducing products through Magento platform is simple and offers different functionality. Allows customers a great experience in terms of purchases. Efficient design allows for easy navigation and an ideal system which customers can easily manage. Zoom image product, the review comments of other customers, a large selection of images for such a product as well as other functionalities are Magento system user simple and inspire visitors to buy and re-visit the web site.
- Optimized for search engines
  Optimization and search are also one of the strength of Magento platform. Different search mechanisms easily using the Magento structure. Magento defines very clear URL names, and also adding tags and keywords in the description. These functionalities directly assist and contribute to improved purchasing and services implementation. Magento uses the powerful tools such as Up-Sells and Cross-Sells to stimulate users to purchase more.
- Mobile devices support
  Web technologies are integrated and supported by the Magento system. Magento platform provides better access to the shopping experience for visitors of different mobile browsers and systems. Systems online sales written in Magento support functionality such as image scaling, integrated video and audio, drag-and-drop functions intended purchase baskets and many other functionalities.
- Analysis and reports
  Analytics and reporting system is also one of Magento strength in business which can identify the best sellers on the site, in terms of brand, manufacturer and profit. Furthermore, this SaaS system can provide

vital insight into which customers, products and regions generate the most profit, making it easier in future decisions on product management and sales forecasting.

- Security and payment
  Magento is very secure platform. Implementation of SSL protocol and dedicated IP address is simple. Using the portal allows the beneficiary easy and secure shopping with using various methods of payment. Because of its structure, enables easy implementation of different models and services for a payment, in the standard package comes with services such as PayPal, Authorize.net, Google checkout and other popular payment systems.

5. INTEGRATION MONGO DATABASE ON MAGENTO PLATFORM

Magento use ORM (Object-relational mapping) approach. Most of the data access will be via the build in Magento models and models which was build from different sources, customized. Magento models, the default one, can be categorized in two ways, there is a basic 'one object one table' model and there is also an Entity Attribute Value (EAV) model. Each model also get a model collection. In PHP programing collection are objects which used to hold a number of individual Magento Model instances.

Magento has a highly flexible and abstract, concept of what the model is. Therefor, Magento models do not contain any connection to the database. Each model use resource class that communicate with the database server. This solution where logical Model and the code that talks to the database are separated, allow us to create the new resources classes for a different database schemas while the keeping the default Magento Model logic structure. (Magento for Developers; www.devdocs.magento.com. 2016)

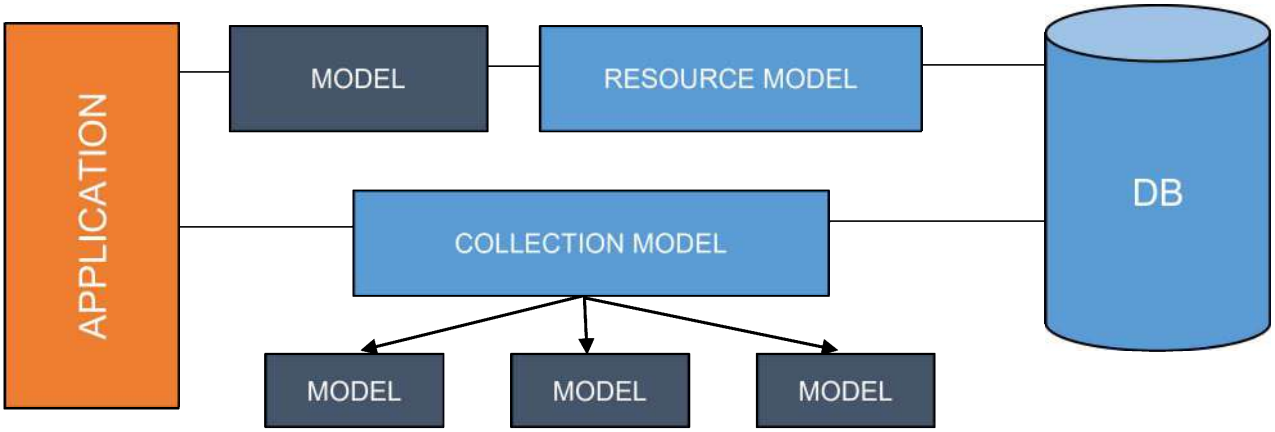


Figure 1: Magento model

Flexibility of EAV (entity-model-view) database model turns into a wound when Magento used it in projects with a very large number of products. At least while using classical relational database. Practice has shown that the classic RDBMS is not quite suitable for large-scale projects, however, be sure to look back a little to other ways of storing data and implement Magento integration with databases of the next generation.

Magento flexibility in terms of product attributes by EAV model maybe the best paint application document-oriented model non-relation databases. Based on the functionality that should be provided, access to the application Mongo database among other documents-oriented databases like NoSQL database that integrates with Magento.
When Mongo database is used, all information regarding a product will be presented as a document. The document in Mongo database can be used to store any kind of data structure, representing different types of products that can be easily extended with new attributes or simplified by removing the attributes in the database. In addition to the flexibility obtained by using document-oriented design Mongo database, we can also count on the scalability and high performance that provide these types of databases.

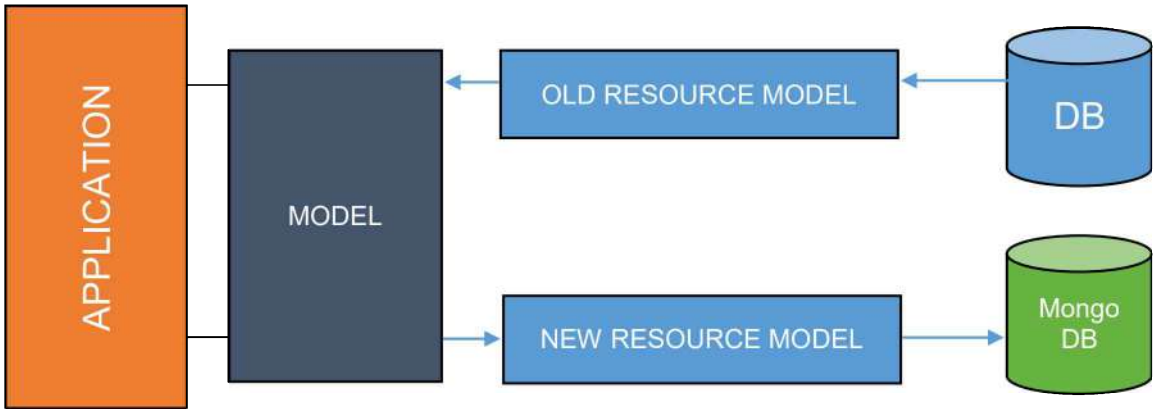


Figure 2: Data migration

The resulting model allows us to go far beyond the limitations of Magento in terms of product management. The changes are significant when it comes to creating products in a single request can see the difference. The collection of products from a huge database of products with a lot of attributes is far more efficient than ordinary connecting table (join) that the use of the classic RDBMS. Often referred to horizontal scalability of NoSQL (Mongo database), but the biggest advantage here is actually related to an improved data model that perfectly suits this purpose.

Through the integration of Mongo database the size and use of database is significantly reduced. Thus, giving more availability for dealing with other tasks and facilitating maintenance. Magento was designed to operate on heterogeneous catalogues containing millions of products, while reducing the impact of the Magento EAV model. The use of the NoSQL Mongo database for storing product attributes reduces the load on the MySQL database while retaining the flexibility of the document model. (Scaling Magento with MongoDB. 2016).

6. FUTURE MODEL IMPROVEMENTS

Future improvement of model is to create resources classes for another Magento entities. Beside product entity, customer model has very big potential to be represented as non-relation data. Analyzing this kind of data can be crucial for business purposes.

7. CONCLUSION

Characteristic of non-relation database (NoSQL) is that it can be easily distributed and infinitely expanded. With combination of infinitely possibilities NoSQL with Magento, we can achieve scalability as we expect.
Today, the standard Magento platform using dedicated servers they'd gone pretty far in databases resources, and reached full capacity. We consider the possibility of replacing a standard relation databases. But, overall, NoSQL databases are not implemented to replace MySQL (relation database). By combining Mongo database as the data warehouse Magento trendsetting products and MySQL database for other data, it came to the optimization in loading the MySQL so the possibility of expanding the base went away a lot further. When we integrate Magento with Mongo database, MySQL database can handle a lot of front servers, make sure these features must be tested in advance. In the future, looking to deploy Mongo database integration NoSQL databases in the Magento platform will become the practice in order to achieve far better results.
With this kind of implementation, when Mongo database integrate with Magento, results can be implementation and support the 30 or 50 million a products at the current time and here big data solutions become solutions that we need.

ACKNOWLEDGMENT

The author would like to thank to the team of Faculty of Organizational Sciences, Department of E-business and management systems, for their support and commitment in the context of the work itself.

REFERENCES

Alan Storm. (2016) Magento Articles for Professional Developers. Retrieved from http://alanstorm.com/category/magento.

Allan MacGregor. (April 4, 2013) Magento PHP Developer's Guide, *Get started with the flexible and powerful e-commerce framework, Magento.*

An Oracle White Paper. (September 2013) Big Data & Analytics Reference Architecture. Available at http://www.oracle.com/technetwork/topics/entarch/oracle-wp-big-data-refarch-2019930.pdf
Christof Strauch. NoSQL Databases. Computer Science and Media (CSM). University Hochschule der Medien, Stuttgart.
Directory of NoSQL databases with basic information on the individual datastores available at http://nosql-database.org/
Magento, Official MVC structure, Magento Inc. 2016 http://devdocs.magento.com/common/images/m1x/Magento_MVC.pdf
Mitch Pirtle. (March 1st 2015) Mongodb for Web Development. 0321705335 (ISBN13: 9780321705334)
MongoDB. MongoDB, Inc. (2016). NoSQL Databases Explained. Retrieved from https://www.mongodb.com/nosql-explained
Smile, open source solution. Netherends (2016). Scaling Magento with MongoDB. Retrieved from http://nl.smile.eu/News/News/Scaling-magento-with-mongodb.
10gen, Inc: MongoDB. (2016) Available at from http://www.mongodb.org

BIG DATA IN POSTAL TRAFFIC AND POSSIBILITIES OF USE

Đorđije Dupljanin*[1], Slaviša Dumnić[1], Predrag Atanasković[1]
[1]University of Novi Sad, Faculty of technical sciences
*Corresponding author, e-mail: ddjordji@uns.ac.rs

Abstract: *The term "big data" has become very popular lately. Universal Postal Union has huge amounts of data and treats these data as a public good. In the past few year and more, postal organizations are talking about the concept of "big postal data". Big postal data are messages about electronic data interchange between postal administrations, ie. real-time scanning of parcels between postal administrations. The aim of this paper is to show where big data are used in postal traffic, as well to explore where they can be used too. It also analyzes the Serbian post and segment that are generating big postal data.*

Keywords*: Big data, big postal data, electronic data interchange, new segments, real-time scanning*

1. INTRODUCTION

The term big data is becoming more and more important. There is a number of people who are interested in it, especially interdisciplinary scientists. To understand what is big data, it is best to start from the definition of that term.

There are many definitions related to big data, but one of the most accepted definition that is commonly found in the literature is: "Big Data is a phenomenon defined by the rapid acceleration in the expanding volume of high velocity, complex, and diverse types of data. Big Data is often defined along three dimensions - volume, velocity, and variety. Big Data is a term that describes large volumes of high velocity, complex and variable data that require advanced techniques and technologies that enable the capture, storage, distribution, management, and analysis of the information (Agarwal et. al, 2012).

If we keep this in mind, it is clear that the postal sector has huge amounts of data, which can be very easy to use to improve their own operations. The paper is divided into several parts. The part big postal data talks about big data in postal sector, where they are generated and how can they be used. The special focus is placed on the POST * Net network of the Universal Postal Union, a special Postal telecommunications network for the exchange of information between the post office, customs, etc. The United Nations, through its Global Pulse initiative, spread awareness of the use of big data. Also, they have a special task force who is investigating new sources of big data, like postal data. Part of the paper is devoted to the use of big data in logistics with concrete examples. The most important part of the paper is identification of big data in Serbian postal system. At the end of the paper everything is summarized in the conclusion.

2. BIG POSTAL DATA

Big data include electronic collection of bits of information through various sources, such as sensors, track and trace systems and more. Post offices are the main generators of big data. Big postal data can help overcome the information gap in areas that are not connected (Anson, J., Helble, M. 2014).

Miguel Luengo-Oroz's speech about big postal data in Geneva at TedXNations event on Dec 11th 2014 pointed to the huge potential of postal data to identify human and economic trends(Universal Postal Union, 2014). Post office processes about 1 billion letters and 16 million packages around the world on a daily basis. Each item is marked with barcodes, postal codes and other bits of information, and that information are followed by the Universal Postal Union and through special electronic networks exchange data with a variety of entities (customs, airports…). The main conclusion of meeting in Geneva is to follow trends that can lead to warnings before the crisis happens in order to take corrective measures (Universal Postal Union, 2014).

More than 100 million records circulated through the POST*Net network in the form of EDI messages. On an annual basis, international postal exchange generates more than 2 billion events, and they are recorded in real time and each event has from 20 -100 records as separate pieces of information, for example: the weight of the postal item, code, city name, postal code, time etc. Figure 1 shows real time scanner of United States postal service. Real time scanning enables the monitoring of postal flows in real time, finding

bottlenecks in the international postal routes, identification of critical barriers and their impact over time (Universal Postal Union, 2013).

Figure 1: Real time scanner

Universal Postal Union has a global postal telecommunications network called the POST * Net, which is used for the transmission of electronic information between airports, customs, post office or other transport organization. The telecommunications network is used exclusively for the purposes of the postal community. Flexible POST * Net infrastructure can meet any postal company. Within this network is circling the huge amount of data that can be used for the improvement of international postal services.

Postal Technology Centre, together with several postal companies, created the International Postal System in 1995. It is an integrated email management application that combines mail processing, operational management and EDI messaging into one application (http://www.ptc.upu.int/ps/ips.shtml).

3. GLOBAL PULSE INITIATIVE AND BIG DATA PROJECTS

Global Pulse is an initiative of the United Nations Secretary-General on big data. The main objective is to discover, develop and adjust big data innovation for sustainable development and humanitarian action. There are numerous Global Pulse's projects in various fields: Climate resilience, Food & Agriculture, Humanitarian Action, Public Health, Real Time evaluation etc (Figure 2) in various regions of the world. The goal of pulse labs, that make the network, the joint efforts of government experts, various UN agencies, academic institutions and private sectors, is to develop new methods of using big data for achieving stated objectives. Labs are located in different parts of the world, with the main labs in New York, Jakarta, Indonesia, Kampala and Uganda. The experts are made up of people from different disciplines: data scientist, data analytics, data engineers ...(http://www.unglobalpulse.org/).

Global Pulse initiative was launched by the UN Secretary General in 2009. By 2014 they have over 25 innovative big data projects and issued 135 press articles. Through various partnerships, Global Pulse gets access to big data which will be used for innovation projects. One of the biggest advantages is that the partnership expands the necessary expertise. Innovation process begins with brainstorming in which everyone participates. After that they create multidisciplinary teams, conducting various analyzes and develop prototypes, then the results are presented to the public. There are various projects carried out by the Universal Postal Union. Through collaboration with the Universal Postal Union, they uncover the new data sources. One of them is “Discovering a new proxy for economic activity”, which analyzes the postal data and the postal sector is being seen as the main economic activator in the community, especially in regions where there is no access to modern information communication technologies (United Nation Glubal Pulse, 2014).

Figure 2: Global Pulse Project Series

4. BIG DATA APPLICATIONS AND CASES FROM THE PRACTICE

Many postal operators create various applications based on big data that enable them to reduce costs, improve interaction with customers, create new products, and that is how they introduce innovations in the postal sector. In the future, the goal is to set up low-cost sensors on vehicles, mailboxes, sorting centers to collect valuable data. DHL has created a tool for the analysis of the correlation between external factors such as weather, flu epidemics, Google trends and shipment data. Result is model that allows predicting volume of packages and determine the number of vehicles and requirements for staff. Italian post set up low cost sensors on electric vehicles to gather the necessary information. Some postal companies are using big data to help those who send direct mailings to better target their campaign. DHL has introduced geomarketing GeoVista tool, that serves companies to identify and analyze the location and potential of the product (U.S. Postal service office of inspector general, 2014).

Special attention is devoted to big data by DHL, and this company emphasizes that logistics and big data are made for each other. They use big data for the last mile optimization using DHL Smart Truck, Crowd-based pick-up and delivery, Predictive network and capacity planning, Parcel Volume Prediction (Jeske, M., Grüner, M., Weiß, F., in cooperation with Detecton consulting 2014).

We also analyzed the Track and trace system of Serbian post and possibility to use big data. Items are scanned and in this way is obtained valuable information like weight of item, postal codes etc. The possibilities for their use are numerous, and they are primarily related to the creation of new services, increase customer satisfaction, innovation, improving efficiency etc. It would be interesting to consider the introduction of modern applications like GeoVista in near future.

5. IDENTIFICATION OF BIG DATA IN SERBIAN POSTAL SYSTEM

In this section there will be represented the parts in which big data are generated during the transfer of postal items. In the production cycle of transfer of postal items, there are 5 production phase:

- Receiving of item
- Shipping of item
- Transport of item
- Arrival of item
- Delivery of item

Production-technological processes of postal services begins with *receving of item*. This phase begins from the moment of acceptance of item from the sender and ends up with stamping the item. The most important conditions that users must be introduced to in order to postal organizations receive a item are:

- Addressing of item
- Packaging of item
- Pay postage

Data at item must be indicated in the following order:

- Name of recipient
- Street, port number, apartment number and zip compartment with a number
- Postal code and the name of the destination post
- Sending destination country for international traffic

The next task for this item is that it must be packed in an appropriate manner to ensure the content of the item. The beneficiary has to pay postage.

Shipping of postal item includes the preparation of items received in units of the postal network for transport towards the destination.

Transport of item is the phase that includes the process of dispatch to arrival.

Arrival of postal items includes the download of packages and the opening of the conclusions by the postal centers or mail in order to delivery.

Delivery of postal item includes delivery to the recipients (Kujačić, M., 2010).

Figure 3. shows the main phases:

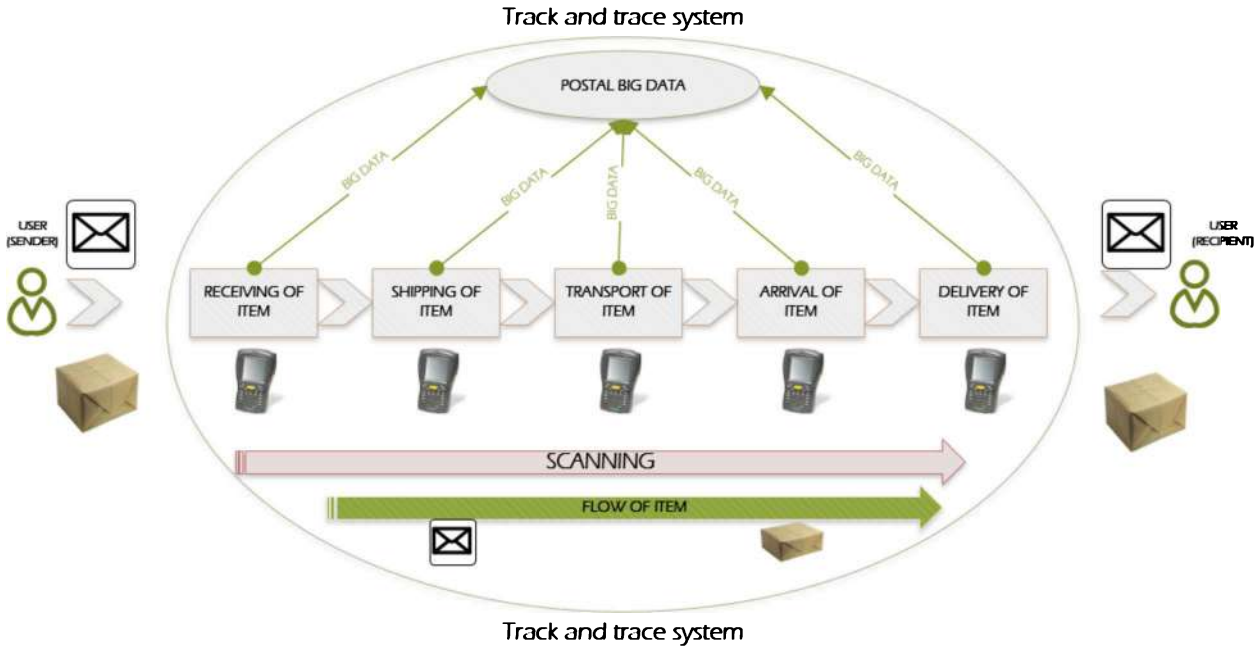


Figure 3: Transfer of postal items and system for tracking

Most of the system for the tracking of parcels and mails (Figure 4) are consisted of the following components (Kujačić, M., 2012):

- Portable Data Terminal (PDT) - handheld computer that is used to scan bar code labels on the items and containers, making sheets of delivery and delivery of item with acceptance of signature and name of the recipient in electronic form
- Workstation for monitoring and control. It consists of computers, printers and printer for bar codes and communication pad
- Host computer system for monitoring and control

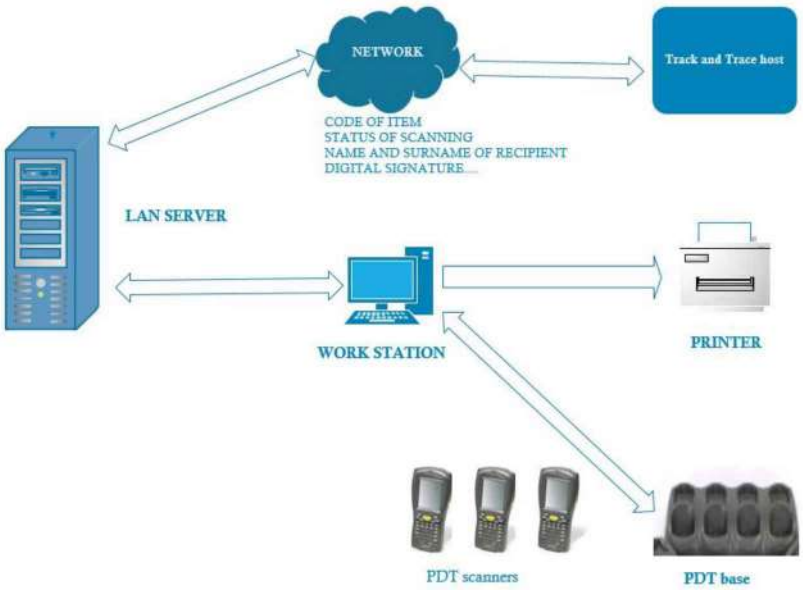


Figure 4: The main components of track and trace system

Items are scanned in all phases of transfer in this system. There is a large amount of postal data such as:

- Code of items
- Address of users
- Full name of the recipient
- Digital signatures
- Sending time
- Weight of items

Such data can be used in various applications:

- Optimization of different internal processes in the company
- Identifying bottlenecks in the system
- Workforce optimization
- Identifying key users
- Determination of the most important regions, municipalities and cities depending on the number of sent items
- Prediction number of items and the active fleet
- Reducing the various types of costs etc.

6. CONCLUSION

Bearing in mind all that is mentioned in previous chapters, it is clear that big data occupy an important place in the postal sector. Large companies realized in time the significance of big data and the use of it in various ways, primarily to create a competitive advantage through the creation of various applications. This is firstly related to leading postal organizations. Postal operator of Serbia can, through various partnerships with these companies, gain the necessary experience, modernize its range of services, and therefore much faster launch innovation. In the near future is expected more intensive development of e-commerce and for this reason the development of some of these applications will be a competitive advantage.

REFERENCES

Agarwal, M., Ajemian, S., Bradley, T., Campbell, R., Coggeshall, S., Cull, B., Gillespie, E., Igoe, J., Jadhwani, P., Johnson, R., Khanna, Y., Mann, B., Muslimani, R., Norton, J., Olson, M., Perkins, S., Ramakrishnan, R., Rosenthal, R., Shacochis, D., Sharma, H., Sullivan, R., Van Chau, M., Wckizer, D. (2012). Demsystifying big data - a practical guide to transforming the business of government, TechAmerica Foundation, Washington.

Anson, J., Helble, M. (2014). Development strategies for the postal sector. An economic perspetive. Chapter 7. Big postal data, nowcasting and the global pulse of the economy, Universal Postal Union.

http://www.ptc.upu.int/ps/ips.shtml

http://www.unglobalpulse.org

Jeske, M., Grüner, M., Weiß, F., in cooperation with Detecton consultin (2014). Big data in logistics, DHL Customer Solutions & Innovation, Troisdorf, Germany.

Kujačić, M. (2010). Poštanske usluge i mreža,

Kujačić, M. (2012). Nove tehnologije i usluge u poštanskom saobraćaju, FTN izdavaštvo, Novi Sad.

United Nation Glubal Pulse, (2014). Annual report UN Global Pulse contents.

Universal Postal Union, (2014). Improving lives hand in hand, Berne

Universal Postal Union, (2013).Tracking the traces of postal big data, Berne

U.S. Postal service office of inspector general, (2014). International postal big data: discusion forum recap.

COMPARATIVE OVERVIEW OF JAVASCRIPT FRAMEWORKS USED IN E-BUSINESS APPLICATIONS

Dušan Zdravković
University of Belgrade, Faculty of Organizational Sciences
e-mail: dusan_zdr@yahoo.com

Abstract: *In this paper I presented the current development and experience using JavaScript and pointed particularly to the two additional functionality as improvement of JavaScript, focusing especially on its use as a real, general-purpose programming language. Since 1995 JavaScript gave web browsers the power to do more than just load web documents. Now, JavaScript programming language is the industry standard client-side scripting language that is used in web applications. JavaScript is supported by all major browsers and is increasingly the foundation of new web development technologies such as Ajax and JSON. Two main improvements of JavaScript language are in the form of library and frameworks. Framework is a web application framework written in JavaScript and describes the structure of the application with main goal to make your app more flexible and scalable and JavaScript library which offers a lot of useful predefined functions that you can call to improve and expand your application. In the market they appeared many projects with the aim to create JavaScript libraries and frameworks that would facilitate writing JavaScript code. I will list the most used libraries and frameworks that exist in the market and their main characteristics and benefits as well as the difference between a library and framework. Many developers do not recommend using a JavaScript library, I will try to show that they can still be useful in projects.*

Keywords: *JavaScript, framework, library, programming, WEB, plugin*

1. INTRODUCTION

With the increasing popularity of the World Wide Web, scripting languages and other dynamic languages are currently experiencing a renaissance. A whole new generation of programmers are growing up with languages such as JavaScript, Perl, PHP, Python and Ruby. The attention that dynamic languages are receiving is remarkable, and is something that has not occurred since the early days of personal computers and the BASIC programming language in the late 1970s and early 1980s. At the same time, the web is becoming the de facto target platform for advanced software applications, including social networking systems, games, productivity applications, and so on. Software systems that were conventionally written using static programming languages such as C, C++ or Java, are now built with dynamic languages that were originally designed for scripting rather than full-scale application development.

JavaScript is a scripting language developed in 1995 by Netscape and added to the Netscape Navigator browser in the same year. JavaScript gave web browsers the power to do more than just load web documents. While JavaScript, as first developed by Netscape (and later Mozilla), has long had a presence on the Web for many websites, it gained a particular pitch with the rise of the Web 2.0 era of computing, in which JavaScript became increasingly used for the development of user interfaces for applications, both web-based and desktop-based. The majority of web sites in the world now use JavaScript and other aspects of the internet such as advertising and analytics and widgets almost depend on its existence.

Now, JavaScript programming language is widely used for web programming and, increasingly, for general purpose computing. JavaScript become the industry standard client-side scripting language that is used in web applications. Scripting is easier to learn and use than many other kinds of programming, and provides a convenient way of automating repetitive tasks or extending applications to provide additional tools for other users. As the industry-standard, must-know scripting language, JavaScript is supported by all major browsers and is increasingly the foundation of new web development technologies such as Ajax and JSON. As AJAX applications gain popularity, client-side JavaScript code is becoming increasingly complex. However, few automated vulnerability analysis tools for JavaScript exist (Saxena et al., 2010).

A variety of projects have sprung up to build reusable JS libraries and frameworks — and at this point, a good number of them have matured and shown staying power that they're worth taking a serious look at and relying on in professional projects. The development of object-oriented frameworks and product line architectures was one of the most important technological leaps forward in the field of computation. This led to the implementation of standardized software architecture which can be specialized by application-specific code, and also

considerably decreased the length of the source code. However, one must take account of the extra effort required for framework development, plus the higher cost input. Framework development seems still to be in its infancy, despite significant developments in the tools and technologies, because of a uniformity of efforts and absence of standards. The recent efforts towards standardization of the UML have led to the hope of harnessing it as a notational basis for projects dealing with framework development, but it is not without lacunae in its constructs (Suman, 2014).

A JavaScript framework is a web application framework written in JavaScript and it differs from a JavaScript library. A library offers a lot of useful predefined functions that you can call to improve and expand your application. A framework describes you the structure of the application and gives you a way to organize your code to make your app more flexible and scalable. You can't call a framework, but it is the framework that will call and use your code in some particular way.

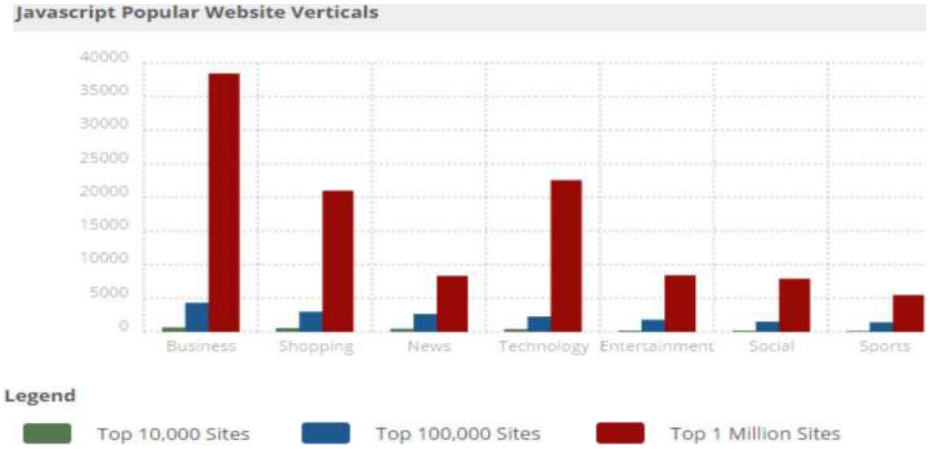


Figure 1: JavaScript popular website

2. JAVASCRIPT LIBRARIES

A JavaScript library is a library of pre-written JavaScript which allows for easier development of JavaScript-based applications, especially for AJAX and other web-centric technologies. With the expanded demands for JavaScript, an easier means for programmers to develop such dynamic interfaces was needed. Thus, JavaScript libraries and JavaScript widget libraries were developed, allowing for developers to concentrate more upon more distinctive applications of Ajax. This has led to other companies and groups, such as Microsoft and Yahoo! developing their own JavaScript-based user interface libraries. Some JavaScript libraries allow for easier integration of JavaScript with other web development technologies, such as CSS, PHP, Ruby, and Java. Many libraries include code to detect differences between runtime environments, and remove the need for applications to allow for such inconsistencies. Almost all JavaScript libraries are released under either a copycenter or copyleft license to ensure license-free distribution, usage, and modification. Some JavaScript libraries, such as YUI, are classified as frameworks since they exhibit full-stack capabilities and properties not found in general JavaScript libraries.

The main arguments against using any JavaScript library have always been speed and size: some say that using a library adds too much download bloat to pages, while others claim that libraries perform poorly compared with leaner custom code.

First, as far as size is concerned, jQuery (for example) is lightweight. The core jQuery library has always had a fairly small footprint—about 19KB for the basics, less than your average JPG image. Any extras your project needs (such as plugins or components from the jQuery UI library) can be added in a modular fashion—so you can easily count your bandwidth calories.

Speed (like size) is becoming a decreasing concern as computer hardware specifications rise and browsers' JavaScript engines grow faster and faster. Of course, this is far from implying that jQuery is slow. Every new release is faster than the last, so any benefit you might derive from rolling your own JavaScript is shrinking every day.

When it comes to competing JavaScript libraries (and there are more than a handful out there), jQuery is the best at doing what jQuery does: manipulating the DOM, adding effects, and making Ajax requests. Still, many of the libraries out there are of excellent quality and excel in other areas, such as complex class-based programming.

jQuery
jQuery is a powerful JavaScript library that can enhance your websites regardless of your background. Creators of the popular jQuery learning resource, share their knowledge, experience, and enthusiasm to make one of the most widely used JavaScript library and to help you to make your web applications shine. For designers, jQuery leverages existing CSS and HTML skills, allowing you to dynamically find and change any aspect of a page. For programmers, jQuery offers an open-source, standards-compliant, unobtrusive approach to writing complex JavaScript applications (Chaffer & Swedberg, 2007). JQuery is the most detected JavaScript library in use on the web. It provides features and functions of JavaScript that not only make JavaScript browser agnostic but also ease the development process.

jQuery makes it easy to play with the DOM, add effects, and execute Ajax requests. In fact, it makes it so easy that you'll often need to pull back from some craziness you just invented, put on your web designer hat, and exercise a little bit of restraint. But there are a multitude of notable factors you should consider if you're going to invest your valuable time in learning a JavaScript library.

Aside from being a joy to use, one of the biggest benefits of jQuery is that it handles a lot of infuriating cross-browser issues for you. Anyone who has written serious JavaScript in the past can attest that cross-browser inconsistencies will drive you mad. For example, a design that renders perfectly in Mozilla Firefox and Internet Explorer 8 just falls apart in Internet Explorer 7, or an interface component you've spent days handcrafting works beautifully in all major browsers except Opera on Linux. Even when cross-browser problems are relatively simple to handle, you always need to maintain a mental knowledge bank of them.

The jQuery team is keenly aware of cross-browser issues, and more importantly they understand why these issues occur. They have written this knowledge into the library—so jQuery works around the caveats for you. Most of the code you write will run exactly the same on all the major browsers, including everybody's favorite little troublemaker: Internet Explorer 6.

This feature alone will save the average developer a lifetime of headaches. Of course, you should always aim to keep up to date with the latest developments and best practices in our industry—but leaving the task of hunting down obscure browser bugs to the jQuery Team (and they fix more and more with each new version) allows you more time to implement your ideas.

Making today's technologies cross-browser compliant is all well and good, but jQuery also fully supports the upcoming CSS3 selector specification, even in Internet Explorer 6.0. Selecting elements you want to change lies at the heart of jQuery's power, and CSS3 selectors give you even more tools to work with.

Separating script behavior from page presentation is best practice in the web development game—though it does present its share of challenges. jQuery makes it a cinch to completely rid your markup of inline scripting, thanks to its ability to easily hook elements on the page and attach code to them in a natural, CSS-like manner. jQuery lacks a mechanism for adding inline code, so this separation of concerns leads to leaner, cleaner, and more maintainable code. Hence, it's easy to do things the right way, and almost impossible to do them the wrong way (Castledine & Sharkie, 2010).

Also included is an assortment of utility functions that implement common functions useful for writing jQuery: string trimming, the ability to easily extend objects, and more. These functions by themselves are particularly handy, but they help promote a seamless integration between jQuery and JavaScript which results in code that's easier to write and maintain.

One noteworthy utility is the supports function, which tests to see if certain features are available on the current user's browser. Traditionally, developers have resorted to browser sniffing—determining which web browser the end user is using, based on information provided by the browser itself—to work around known issues. This has always been an unsatisfying and error-prone practice. Using the jQuery supports utility function, you can test to see if a certain feature is available to the user, and easily build applications that degrade gracefully on older browsers, or those not standards-compliant.

The jQuery team has taken great care in making the jQuery library extensible. By including only a core set of features while providing a framework for extending the library, they've made it easy to create plugins that you can reuse in all your jQuery projects, as well as share with other developers. A lot of fairly common functionality

has been omitted from the jQuery core library, and relegated to the realm of the plugin. Any additional required functionality can be included easily on a page-by-page basis to keep bandwidth and code bloat to a minimum. Thankfully, a lot of people have taken advantage of jQuery's extensibility, so there are already hundreds of excellent, downloadable plugins available from the jQuery plugin repository, with new ones added all the time. Whenever you're presented with a task or problem, it's worth checking first to see if there's a plugin that might suit your needs. That's because almost any functionality you might require has likely already been turned into a plugin, and is available and ready for you to start using. Even if it turns out that you need to do some work yourself, the plugin repository is often the best place to steer you in the right direction.

jQueryUI
jQuery has already been used to make some impressive widgets and effects, some of which were useful enough to justify inclusion in the core jQuery library itself. However, the jQuery team wisely decided that in order to keep the core library focused, they'd separate out higher-level constructs and package them into a neat library that sits on top of jQuery.

That library is called jQuery User Interface (generally abbreviated to just jQueryUI), and it comprises a menagerie of useful effects and advanced widgets that are accessible and highly customizable through the use of themes. jQueryUI is a collection of GUI widgets, animated visual effects, and themes implemented with jQuery (a JavaScript library), Cascading Style Sheets, and HTML. jQueryUI is used on over 197,000 of the top one million websites, making it the second most popular JavaScript library.

Accordions, sliders, dialog boxes, date pickers, and more—all ready to be used. You could spend a bunch of time creating them yourself in jQuery but the jQueryUI controls are configurable and sophisticated enough that your time would be better spent elsewhere—namely implementing your unique project requirements rather than ensuring your custom date picker appears correctly across different browsers.

3. JAVASCRIPT FRAMEWORKS

In computer programming, a software framework is an abstraction in which software providing generic functionality can be selectively changed by additional user-written code, thus providing application-specific software. A software framework is a universal, reusable software environment that provides particular functionality as part of a larger software platform to facilitate development of software applications, products and solutions. Software frameworks may include support programs, compilers, code libraries, tool sets, and application programming interfaces (APIs) that bring together all the different components to enable development of a project or solution. Frameworks contain key distinguishing features that separate them from normal libraries. In a framework, unlike in libraries or normal user applications, the overall program's flow of control is not dictated by the caller, but by the framework. A framework has a default behavior. This default behavior must be some useful behavior and not a series of no-ops. A framework can be extended by the user usually by selective overriding or specialized by user code to provide specific functionality. The framework code, in general, is not supposed to be modified, while accepting user-implemented extensions. In other words, users can extend the framework, but should not modify its code. Frameworks and tools have been built to make using JavaScript easier or to provide specific functionality for other website functions. However, since JavaScript is such a flexible and dynamic language, each framework can present very different approaches to the problems of web development — each with its own pros and cons. As such, improving the correctness, security and performance of JavaScript applications has been the driving force for research in type systems, static analysis and compiler techniques for this language (Richards et al., 2010).

In the times of rapid app development, we need better ways to quickly develop interactive web applications and that is where JavaScript frameworks come to the rescue. JavaScript frameworks are the backbone of single page web applications development and provide superpowers to plain HTML and JavaScript. Use of JavaScript frameworks give you space to focus on developing interactive elements of the user interface without worrying too much about code structure and code maintenance. All JavaScript frameworks can be written in an accessible way with graceful degradation, frameworks seen here which imply out-of-the-box accessibility have made a special effort to document best practices for their particular framework. In web application development, framework is a collection of technologies for building dynamic web pages on the client side. Most of the JavaScript frameworks work on MVC design paradigm and enforce structure to ensure more scalable, reusable, maintainable JavaScript code. It however is not necessary that all frameworks ride on MVC pattern.

These are some JavaScript frameworks that are most advanced, feature rich, popular among developer community and make it possible to build complex and feature rich single page interactive web applications.

Prototype
Prototype was one of the first JavaScript libraries to gain prominence during the Web 2.0 resurgence. When the term AJAX was first coined in 2005, making cross - browser XMLHttpRequests was a minefield of browser - specific code. Prototype assists you in your quest for cross - browser compatibility by smoothing out the rough edges of event handling by providing a common method for binding events to their respective handlers and providing a common interface for creating AJAX requests that work in all browsers. It also gives you a cross - browser way to manipulate the DOM, by handling the special cases in all browsers, and allowing you to focus on just writing code without cluttering up your code with browser - specific " if - else " statements. Prototype extends the JavaScript language as well as the elements. The native JavaScript object is extended to include methods for determining the type of data the object represents as well as helpful serialization methods. The enumerable class allows you to easily traverse and manipulate your arrays of both JavaScript objects and DOM elements by providing useful methods such as each() and map() directly on your arrays. The native function object is also extended with useful methods, such as wrap(), which let you write interceptors for your methods that provide useful features like logging. Prototype eases inheritance with the class object. You can easily extend your objects and create hierarchies without the headaches associated with normal inheritance in statically typed languages.

All of these features make Prototype the best choice for writing logic in JavaScript, and it provides you with an excellent base for writing your own JavaScript library. Since Prototype does all of the heavy lifting for you, you can focus on the fun parts of library development — creating new widgets and data structures. Prototype is an excellent framework to use either as your main JavaScript library or as the foundation of another library.

Part of the magic of Prototype is the extension of DOM elements by the framework. By adding new methods to elements, Prototype makes it easier to write cross - browser code in a more eloquent manner. It is easier to write unobtrusive JavaScript by taking advantage of helper methods such as getElementsByClassName and getElementsBySelectors, making it easy to apply styling or events to groups of elements with something in common. By extending the elements you are working on, Prototype is able to centralize all of the cross - browser hacks that make JavaScript programming such a chore. Prototype keeps its extension methods for all elements in the Element.Methods and Element.Methods.Simulated object. If the element is an input, select, or textarea tag, the methods in Form.Element.Methods are also included. Form elements themselves are extended with the methods in Form.Methods. Most of these methods return the original element, so you can chain together methods like so: $(myElement).update("updated").show();. It is important to note that not only is the element you choose extended, but all of the child elements of that element are also extended. In browsers that support modification of the HTMLElement.prototype, Prototype adds the methods to HTMLElement for you. That means you don't have to call Element.extends() on any element you create by hand. The easiest way to extend a DOM element is to use the $() function to get a reference to the element rather than using document.getElementById or some other method.

Prototype was one of the first major JavaScript libraries to make cross - browser AJAX calls less painful. It can automatically interpret JavaScript and JSON responses from your server. It makes it easier to update your user interface with data requested from your server at periodic intervals and controls how often requests are made to your server. With Prototype, your form elements are extended the same way your other HTML elements are, but with a few specific methods. Using the $F() method, you can quickly get the value of any form element on your page. The Form.Elements object contains methods that Prototype uses to extend your form elements. You can easily serialize all of your form elements into an object literal or a string suitable for passing into an AJAX call (Orchard et al., 2009).

AngularJS
It was first released in 2009 and made available as open source framework under MIT license. Ever since its release, Angular ecosystem has grown beyond imagination. It currently boasts the biggest community of developers and is the most used JavaScript framework for developing Single Page Web Applications.

AngularJS framework gives a set of functionality to HTML by adding all the necessary features required to build dynamic views (interactive user interface). It gives option to extend HTML attributes by the use of Angular directives. Extending HTML with AngularJS is very simple, one can use standard AngularJS directive or develop a custom directive and mount it on any div. When AngularJS compiler compiles and renders the HTML on user interface, it does the DOM manipulation and attaches all features provided by the directive used. Of course, this is just one aspect of how AngularJS can be used to empower web applications. When user interacts with the interface and provides an input, the view and the model (JavaScript objects) are synchronized, the logic in the model is executed and the DOM gets updated. The reverse is true as well, if model gets updated, view is re-rendered. This essentially takes away all the problems of writing manual code for DOM manipulation.

Recently released Framework ReactJS is giving tough competition to AngularJS but AngularJS is holding the ground tight and growing in demand as ever before. The main reason behind Angular's continuous growth is the improvements and advancements it brings in with every new release.

React
React JavaScript framework is behind the user interface of Facebook as well and Instagram. This gives us a quick idea about how powerful is React when it comes to building large scale applications of extreme dynamic nature. React was first released as open source in 2013 under BSD license. The community is growing rapidly ever since its release and probably it is one of the fastest growing JavaScript framework as of today.

React is best at rendering complex user interfaces with high performance. The basic fundamental behind React is the concept of virtual DOM. React utilizes a virtual DOM, which can be rendered either at client side or server side and communicate back and forth. When the data manipulation is much more dynamic and complex, client side DOM manipulations become performance intensive. The React approach to handle this is – render the DOM at server side, the virtual DOM. Update only the selective/changed nodes of browser DOM instead of re-rendering the entire DOM. Another biggest advantage of React is the re-usability it brings on the table in the form of reactive components. React component libraries can be created and used across applications or made available for public use.

MooTools
MooTools (My Object-Oriented Tools) is a lightweight, object-oriented JavaScript framework. It is released under the free, open-source MIT License in September 2006.

MooTools provides the user with a number of advantages over native JavaScript. An extensible and modular framework allowing developers to choose their own customized combination of components. MooTools provides a detailed, coherent application programming interface (API) as well as a custom downloads module allowing developers to download only the modules and dependencies they need for a particular app. An advanced effects component, with optimized transitions such as easing equations used by many Flash developers (Newton, 2008). Enhancements to the DOM, enabling developers to easily add, modify, select, and delete DOM elements. Storing and retrieving information with Element storage is also supported. The framework includes built-in functions for manipulation of CSS, DOM elements, native JavaScript objects, Ajax requests, DOM effects, and more.

Ember.js
Ember.js is another powerful MVC JavaScript framework. Ember.js was initially released in 2011 as open source JavaScript framework by Yehuda Katz under MIT license. It competes with AngularJS and React when it comes to building interactive frontend user interfaces and also has a very active community of developers.
Ember.js also rides on the principal of two way data binding like AngularJS, i.e. update view when model changes and update model when the view changes, keeping both in sync all of the time. It is coming up with Fastboot.js module that allows server side rendering of DOM, the concept similar to what React is already using for better performance in complex UI rendering. Ember.js targets the best of both AngularJS (two way data binding) and React (server side rendering).

Aurelia
Aurelia is the creation of Rob Eisenberg and team who come mostly from the world of AngularJS and Durandal. Aurelia though is an open source product is officially managed by Durandal Inc., a startup company that creates libraries, tools and frameworks to support next generation of web development.

Aurelia is released in January 2015, and is ready for production use. It extends the capabilities of Durandal and is termed as NextGen version of it by Eisenberg. For the existing developers who work in Durandal or Angular1 and 2, Aurelia comes with a clear migration path. It is managed by highly professional community and carries a great legacy.

A power fact about Aurelia is that it is highly modularized and comprises of many independent small libraries. One can use entire framework in the project, use few of the required libraries, or extend the selected libraries to create custom framework. Aurelia is self-contained package and doesn't have any external dependencies except for polyfills.

Meteor
Meteor is the magical full stack platform for building end to end mobile and web applications completely in JavaScript. Meteor is the power player and comes equipped with all the features you need for front-end rendering, back-end development, business logic and database management. It was first released in 2012. by Meteor Development Group as an open source JavaScript framework under MIT license.

The best thing about Meteor is that you use only JavaScript for end to end application development, no need to invest time learning anything else. Meteor is modular and the packages and libraries can be used on demand.

The server side packages run in the Node.js and you do not need anything else but Meteor packages to access the database, all in JavaScript. This makes Meteor applications real time web applications. From performance perspective, any changes in the database are reflected back on the user interface in the real time and vice versa without the handshake between different languages or without major overhead of server response times.

Backbone.js
It was first released in 2010 by Jeremy Ashkenas as open source JavaScript framework under MIT license. The popularity and power of Backbone.js can be judged from the fact that biggies like Pinterest, Foursquare, Walmart, Disqus and Delicious are using Backbone.js. This is just a small subset of Backbone.js users.

The good thing about Backbone.js is that it is simple, small size package and easy to learn. You can get started building apps with Backbone.js JavaScript framework within no time. Backbone.js is very flexible in a way that it comes with just the minimal and you can build anything on top of it, by writing your own code or by using third party JavaScript frameworks. One can even build a fully functional opinionated framework with Backbone.js at the core. It is very useful but more as a side framework rather than the core framework of your web project.

Polymer
Polymer was released by Google back in 2013 Polymer uses the concept of web components to extend HTML capabilities.

Web components is the browser technology released by W3C using which new custom HTML elements can be created. For example <audio> is a standard HTML5 element but with the web components and related technologies you can create your own custom element - like <my-audio>. Polymer gives powers and brings structure in building custom HTML elements using browser based technologies that includes web components.

Knockout
Knockout was initially released by Steve Sanderson in 2010 as open source JavaScript framework under MIT license. Knockout works under the MVVM design paradigm and that makes it a little different from Ember.js and AngularJS.

Knockout has had its golden time but as of now it is growing at a much slower pace as compared to the earlier competitors like AngularJS, Ember.js or Backbone.js. The slow growth is simply because it lags way behind in terms of improvements and adding more features. Knockout has a great legacy and can definitely make a come back but only if someone else adopts it and starts nurturing it with the latest and greatest of the world of JavaScript technologies.

Vue.js
Vue.js is the creation of Evan You. It was first released in 2014 as open source framework for public use under MIT license. Vue.js is relatively new and is gaining lot of traction among the community of developers. Vue.js works with MVVM design paradigm and has a very simple API. Vue.js demonstrate minimalism to the extreme and allows you to use selective modules, as required. Vue.js is inspired by AngularJS, React and Knockout and updates model and view via two way data binding. While Vue.js is not in the league of AngularJS or Ember.js but conceptually has all the potential to be the JavaScript framework of future and hold respectable market share.

Figure 2 shows the percentages of websites using various JavaScript libraries and frameworks. A website may use more than one JavaScript library or framework. JQuery is used by 70.1% of all the websites, that is a JavaScript library market share of 96.0% and 27% of the websites use none of the JavaScript libraries or frameworks.

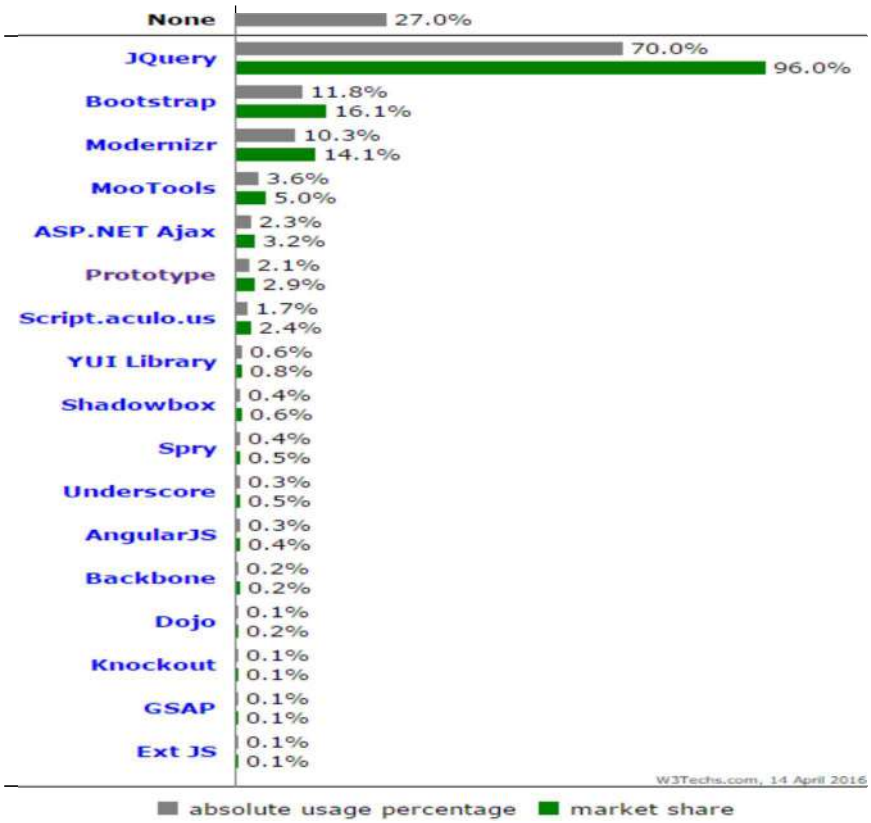


Figure 2: Usage of JavaScript libraries and framework

3.1. Frameworks to build mobile application with HTML, CSS & JavaScript

The emergence of mobile and ubiquitous technologies as important tools to complement formal learning has been accompanied by a growing interest in their educational benefits and applications. Mobile devices can be used to promote learning anywhere and anytime, to foster social learning and knowledge sharing, or to visualize augmented reality applications for learning purposes. However, the development of these applications is difficult for many researchers because it requires understanding many different protocols, dealing with distributed schemas, processes, platforms, and services, learning new programming languages, and interacting with different hardware sensors and drivers. For that reason, the use of frameworks and middleware that encapsulate part of this complexity appears to be fundamental to the further development of mobile learning projects. There been a study to analyze the state of the art of frameworks and middleware devoted to simplifying the development of mobile and ubiquitous learning applications (Martin et al., 2011).

One key advantage of using web technology to build your app is portability. Using a packager/compiler, like PhoneGap, you will be able to port and install your app on many different platforms. There are a number of frameworks that make this possible. They also have done half of the hard work to bridge the gap between web and mobile platforms. PhoneGap provides a set JavaScript APIs that connect to the device's native functions such as camera, compass, contacts, and geolocation. PhoneGap lets us build a mobile application without the native programming language. Instead we can use a framework like jQuery Mobile. It will compile your app using the platform's SDK and will be ready to install on the platform it supports including iOS, Android, Windows Phone, Blackberry and Web OS.

The mobile app development landscape is changing very rapidly with developers moving from native to HTML5 based hybrid app development options. The biggest advantage of hybrid mobile apps is "write once and run everywhere" approach.

JQuery Mobile

jQueryMobile suite is still in the game and holding the ground tight against the feature rich hybrid mobile app development frameworks like Ionic, Onsen UI and Framework 7. The die-hard jQuery fans community has built this minimalist jQueryMobile package on top of solid jQuery and jQueryUI foundation. The focus of jQueryMobile is to empower developers to build web apps and mobile apps that run seamlessly and with unique user experience across mobiles, tablets and desktops. It doesn't focus much on providing native look and feel to apps for individual platforms like iOS or Android. jQueryMobile is a robust mobile development

framework to build cross-mobile-platform app. jQueryMobile support a wide range of different platforms, from a regular desktop, smart phone, tablet, or an e-reader device like Nook or Kindle. Similar to its sibling, jQueryUI, jQueryMobile comprises a number of UIthat, in this case, is optimized for mobile and touch-enabled devices.

Mobile Angular UI
This one is for the fans of Bootstrap and AngularJS. With Mobile Angular UI, you get best of both Bootstrap 3 and AngularJS framework to build HTML5 mobile applications. Angular UI is more like an extension to Bootstrap 3 but without any dependencies to bootstrap.js or jQuery. It utilizes Fastclick.js and Overthrow.js for smooth and better mobile experience. Mobile Angular UI provides directives for building UI component like overlays, switches, sidebars, scrollable areas and absolute positioned navbars that don't bounce on scroll. These essentially are the components that you find missing in Bootstrap 3 for building mobile apps. Mobile Angular UI is available as open source and free to use under MIT license.

Sencha Touch
Sencha Touch is a mobile framework powered by HTML5 and CSS3, providing APIs, animations, and components that are compatible with the current mobile platforms and browsers. Sencha Touch supports both Cordova and PhoneGap. You can compile your app, and submit your app to the respective platform's app stores. In addition, Sencha Touch provides a set of themes for iOS, Android, Blackberry, Windows Phone, Tizen, and a variety of other platforms to help your app feel like a native app.

Ratchet
Ratchet was originally used by Twitter as an internal tool to create their mobile app prototype which is then released publicly as an open source project. Ratchet comes with a collection of User Interface and JavaScript plugins for building simple mobile apps, providing reusable HTML classes. In version 2.0, Ratchet is also shipped with its proprietary font icon set named Ratcheticon and two pre-made UI themes for iOS and Android.

Ionic
Ionic is an HTML5 mobile framework with focus on performance, by leveraging hardware acceleration, and it requires no third-party JavaScript library. It works best together with AngularJS to build an interactive app. Similar to Ratchet, Ionic is shipped with a nicely crafted font icon set, Ionicons, and a bunch of reusable HTML classes to build the mobile user interface.

Lungo
Lungo is a lightweight mobile framework based on HTML5 and CSS3. It has very nice default styles that you can use as a starting point to design your mobile app. Aside for the mobile user interface components, Lungo brings a number of JavaScript API to control your app. Lungo supports the following platforms: iOS, Android, Blackberry and Firefox OS.

Famo.us
A new mobile framework block, Famo.us promises to eliminate HTML5 performance issue on mobile devices with its lightweight JavaScript engine (only 64k). Famo.us, reportedly, will also launch a cloud-based service to package your app to publish to the AppStore. Famo.us is another powerhouse HTML5 apps development framework and targets to provide near native experience in hybrid apps. The main difference between Famo.us and other hybrid HTML5 frameworks is that it focuses more on graphics rendering, 2d and 3d and hence is more suitable for games development.

4. CONCLUSION

Phenomenon of JavaScript frameworks is not very old but has grown at a very fast pace in the last couple of years. JavaScript frameworks have become the default choice for creating complex user interfaces, specifically for Single Page Web Applications.

Different frameworks offer different concepts and methodology but attempt to solve the common underlying problem of rendering complex user interfaces dynamically and making single page applications much more useful and fast. The frameworks mentioned in this article are among the best and most widely used JavaScript frameworks on the market today. They all help to simplify writing code, but each of them is oriented towards a concrete problem and according to these characteristics the developers use different frameworks in their projects. New frameworks are constantly appear on the market while some disappear from use depending on the support and continuous development that the founders provides. Open source frameworks are more common in usage because they provide the programmer ability to adapt them to himself. It is difficult to allocate some of these frameworks as the best to use because each of them offers its own characteristics which more or less means in different projects so I did not do a comparison of frameworks but only mentioned the most

frequently used and cited their improvements of basic JavaScript. On the programmer is to choose the framework toward its affinities and needs.

At the other side, the main arguments against using any JavaScript library are that using a library adds too much download material to pages, while others claim that libraries perform poorly compared with leaner custom code. I wrote this text from my experience of using JavaScript libraries. In my projects I use jQuery library that gives me all the benefits of writing easier and simpler code with fewer lines. Its producers are trying to continually improve their product and constantly new versions are available to download. Each subsequent enhancement reduces the unnecessary content and adds a new features that are required for use in practice. I do not think it complicates the project and that makes it massive, quite the contrary, it helps in simple programming. I hope that listing type JavaScript library successfully reassure all those who were skeptical of using JavaScript libraries.

REFERENCES

Castledine, E., & Sharkie, C. (2012). jQuery: Novice to Ninja: New Kicks And Tricks (2nd ed.), SitePoint, Australia

Chaffer, J., & Swedberg, K. (2007). Learning jQuery: Better Interaction Design and Web Development with Simple Javascript Techniques, Packt Publishing, Birmingham, UK

Ghatol, R., & Patel, Y. (2012). Beginning PhoneGap: Mobile Web Framework for JavaScript and HTML5, Apress Berkely, USA

Martin, S., Diaz, G., Plaza, I., Ruiz, E., Castro, M., & Peire, J. (2011). State of the art of frameworks and middleware for facilitating mobile and ubiquitous learning development. Journal of Systems and Software, 84 (11), 1883–1891. doi:10.1016/j.jss.2011.06.042

Newton, A. (2008). MooTools Essentials: The Official MooTools Reference for JavaScript and Ajax Development (1st ed.), Apress Berkely, USA

Orchard, L., Pehlivanian, A., Koon, S., & Jones, H. (2009). Professional JavaScript Frameworks: Prototype, YUI, ExtJS, Dojo and MooTools, Wrox Press, Birmingham, UK

Richards, G., Lebresne, S., Burg, B., & Vitek, J. (2010). An analysis of the dynamic behavior of JavaScript programs. ACM New York, 45(6), 1-12. doi:10.1145/1809028.1806598

Saxena, P., Akhawe, D., Hanna, S., Mao, F., McCamant, S., & Song, D. (2010). A Symbolic Execution Framework for JavaScript. IEEE Symposium on Security and Privacy, 513-528. doi: 10.1109/SP.2010.38

Suman, A. (2014). From Knowledge Abstraction to Management Using Ranganathan's Faceted Schema to Develop Conceptual Frameworks for Digital Libraries. Chandos Publishing, doi:http://dx.doi.org/10.1108/OIR-10-2014-0227

ENTREPRENEURSHIP 475

ANALYSIS OF STAGES IN THE LIFE CYCLE OF FAMILY SMEs IN THE REPUBLIC OF SERBIA 476
Mihic Marko, Arsic Sinisa, Arsic Milos

ARGUMENTS FOR DESIGNING PROGRAMMES FOR ENCOURAGING THE YOUTH IN SERBIA TOWARDS ENTREPRENEURSHIP 484
Omerbegović-Bijelović Jasmina, Mirković Predrag, Rakićević Zoran

COMPANY'S GROWTH AS A RESULT OF ENTREPRENEUR'S CREATIVE ABILITIES 495
Peljko Žiga, Jeraj Mitja, Marič Miha

FEMALE ENTREPRENEURSHIP: MAIN CHALLENGES AND THE IMPACT OF GENDER GAP 504
Kokotović Dunja, Rakić,Bogdan Kokotović Tijana

ORGANIZATION SPECIFICS OF SMALL AND MEDIUM ENTERPRISES WITH A SPECIAL OVERVIEW OF MARKETING FUNCTION 513
Vukmirović Valentina, Vukmirović Nikola

WOMEN'S ENTREPRENEURSHIP - A GLOBAL PERSPECTIVE AND CURRENT STATE IN SERBIA 522
Vrbanac Maja, Milovanović Marina, Perišić Jasmina

ENTREPRENEURSHIP

ANALYSIS OF STAGES IN THE LIFE CYCLE OF FAMILY SMES IN THE REPUBLIC OF SERBIA

Marko Mihic*[1], Sinisa Arsic[1], Milos Arsic[2]
[1]Faculty of organizational sciences, University of Belgrade, Belgrade, Serbia
[2] Faculty for Traffic, Communications and Logistics, Berane, Montenegro
*Corresponding author, e-mail: mihicm@fon.rs

Abstract: *This paper aims to analyze the operating life cycle of small and medium-sized enterprises (SMEs) in Serbia, with a special focus on family businesses. After an empirical research, it was concluded that the problem stems from the uniqueness of different stages in the life cycle of family-owned SMEs in Serbia. The main presumption of this analysis is that most (newly-founded) family firms are currently facing a decline stage in their life cycles, as well as that the most common strategy for exiting this phase seems to center around layoffs or other drastic measures. After examining the results of the study, the authors analyzed typical strategies used by owners of family businesses in order to reinforce their firms and encourage growth. The main conclusions of this study are presented with the fact that the majority of family businesses in Serbia are currently in the decline stage of their life cycle.*

Keywords*: life cycle, family business, entrepreneurship, strategy*

1. INTRODUCTION

The entire operational life cycle of an SME is influenced by the owner, across five stages: from starting the business venture, through growth, professionalization and integration, to the consolidation of operations. The sixth stage, i.e. decline or stagnation, is the least desirable stage for any owner, but once it starts, it is necessary to create an adequate business revitalization strategy immediately, i.e. the owner must devise a plan that would lead the business to a new expansion (Smithson, 2004).

This paper focuses on family-owned SMEs in Serbia. Its aim is to analyze the stages of their life cycle, both those they have passed and those they are currently facing. The main challenge in front of the authors was to identify the features of the six abovementioned stages in business life cycle. The task was performed in two stages: through a theoretical overview of available literature, as well as through the identification of questions relevant for Serbian family SME sector and adequate for empirical evaluation. In Literature Review, the authors will present the first (theoretical) part of the analysis using a synthesis of survey questions. The questions that were identified as vital and relevant for this research will be examined in the Empirical Research chapter. Previously to this, the authors will define the research problem in a separate chapter, as it is insufficiently presented in the existing literature and studies. This theoretical gap will be studied using an adequate representative sample. The Discussion on the results of this research offers authors' opinions relating to the conclusions they adopted, as well as to available strategies aimed at helping SMEs overcome the decline/stagnation stage. This section of the paper also presents conclusions from other similar studies, and explains identified literature gaps, which this study aims to fill. The limitation of this study is the relatively small number of surveyed companies, but that limitation was compensated for by selecting companies evenly distributed throughout the territory of Serbia, in order to provide the best possible territorial representativeness of the sample.

2. LITERATURE OVERVIEW

In the initial stage of a company's life cycle, the firm's structure is still not completely defined, responsibilities are not properly established and distributed, and there is no coherency in following the initial plan, since these firms tend to implement temporary and simple solutions. (Abdesselam, Bonnet & Le Pape, 2004). In this stage, companies are extremely vulnerable; many of them never overcome this phase and simply disappear. Therefore, it is necessary to detect and analyze problems that prevent a business from developing and continuing into the next stage of its life cycle.

The next stage, if the firm gets to it, is the one where employees and the owner create a base the firm will rely on in the future and foster important prerequisites for succeeding on today's competitive market. In this stage, business operations are at their very beginning; the owner is performing most of the tasks and has,

sometimes, a few employees to help him. The main problems and tasks revolve around attracting new customers and delivering products and services. Some companies never enter the expansion stage because the owner, lacking ambition, decides to keep the operations at the same level, further implementing the stages of professionalization and integration (Sharma & Salvato, 2011). Nevertheless, the companies that strive towards expansion will start to glance outwards, looking for new possibilities and business ventures. Still, these prospects only represent the extension of the already existing activities and not the search for completely new activities and cooperation with third parties. The company's structure will begin to take form, relying on the already existing base it can return to at any moment (Barbero, Casillas & Feldman, 2011). It is necessary to establish whether the owners of family SMEs mainly opt for expanding their product or service range (outside of Serbian borders, if possible), or for remaining at their current business operations level, implementing professionalization and integration, hoping to achieve success on the market.

The professionalization and integration stage is analogue to the growth and development of a human between adolescence and maturity. The ideas advocated by the firm in this stage are indisputable, even stubbornly defended, although they change in frequent intervals. One of the greatest dangers in this stage is the success of one employee, most often the owner, who controls the entire structure. The company is financially stable with average or above-the-average profits; an opportunity arises to hire functional managers who will take over certain activities previously performed by the owner. If the company does not adjust to the changes, it can shut down or return to the previous stage (the expansion stage). As long as the owner is there in person, he brings revenue and everything works fine. When he is gone, there is a danger of creating a vacuum, generated by the lack of a true leader in the organization (Peiser & Wooten, 1997). Professionalization and, later, integration are very important for a company because relations between employees can create a challenging environment for understanding and maintaining everyday business operations. The expansion of a company has to precede professionalization, since professionalization is there to support the new, changed structure. The entire business operations system has to be systematic; this process is achieved through integration. Managers now need another level of management and professionalization process is there to establish a clear structure for responsibilities, delegation of tasks, establishing of roles, etc. (Jovanovic, Petrovic, Mihic & Obradovic, 2012). New experts are joining the firm, and the organization starts to prepare for consolidation, i.e. stabilization of current operations. The owner now needs experts for managing finances in order to deal with debtors, creditors and bank managers. Every small firm, striving to become a medium-sized company, i.e. big company at some point, has to make this leap in order to ensure long-term development. In this stage, the owner invests cash and borrowed assets aiming to invest in the company's further development (Johnsen & McMahon, 2005; Muhlbacher, Nettekoven & Kovac, 2011). Strategic management is becoming critical and the owner is involved in every stage. At this point, any failure can push the company back into the stagnation or survival stage to such an extent that it can even be sold.

Consolidation stage further determines operational directions from a safe point. Nevertheless, it is only up to the owner and his plans whether his business will enter the next downhill stage, i.e. whether the business will expand even further. A consolidated company offers security and sense of determination to its employees, encouraging them to achieve their goals. The company that overcomes this stage knows what to expect from its employees, and they know what is expected of them. Among other things, this is a result of increasingly formal relations in the company, something less consolidated companies do not have. In this stage, there is a danger of turning formalities into burdening bureaucracy, smothering all good effects in excessive paperwork and formal procedures. The best possible way in which an owner and a team of managers can protect their business is to constantly train and develop their staff. This strategy should be aimed at developing creative employees who do not perform their tasks always in the same manner and repetitively every day. In this way, they make positive contribution to the system with their results and always look for new solutions and approach in order to prevent stagnation and delays caused by rules and procedures. Lucky companies, the ones that are successful in the long run, reach consolidation and remain in that stage as long as they exist (Dodge & Robbins, 1992; La Rocca, La Rocca & Cariola, 2011; Barbero & Casillas, 2011).

From this point, the company usually slides into decline or stagnation stage. The key problem is how to finance growth and whether the owner is ready to delegate responsibilities to others. If the efforts made during this stage fail, the company closes or returns to a previous stage. In most cases, such company will lay off employees and lose projects, until the owner decides to close it or sell it to someone. Stagnation can last for years, due to the false conviction that not all is lost yet. However, in the end, such sequence of events always leads to closing the company (Smithson, 2004; Rutherford, Muse & Oswald, 2006). Therefore, we first need to establish what percentage of companies is in the decline or stagnation stage, and then to determine what is the cause of such state, i.e. whether it is a consequence of failure to expand the range of products/services or failure to export to foreign markets. Another critical issue analyzed by the authors of this paper is the owners' plan for exiting the crisis – either by shutting down production or by other means.

With all the above mentioned, it can be said that since the founding of a company, during its development and in its maturity stage, it undergoes a diversification of business operations, expanding its client portfolio and activities, while the downward trend during the last stage of a company's life cycle reduces the number of its business activities and clients, leaving the company to operate only in a limited number of areas. The same rule applies to labor force – up until a company reaches maturity stage, it takes in more non-professionals, while after this stage, more and more of these employees leave the company. (Graafland, van de Ven & Stoffele, 2003; Masurel & van Montfort, 2006; Muhlbacher et al., 2011). In addition, the productivity of employees increases until the maturity stage, and experiences a downward trend as the company enters the final stage of its life cycle. According to (Headd & Kirchhoff, 2009; Herbane, 2010; Sharma & Salvato, 2011), the most common causes of closing a business in the decline stage are managerial incompetency (inexperienced managers found startups without a proper background and training), limitation of business operations to a single market (failure to offer new products in the market), inadequate control (losing the perspective and control processes focus), and insufficient capital (company debt is enlarged due to new loans).

Unfortunately, there are much fewer reasons why a company will succeed. According to (Walker & Brown, 2004; Johnsen & McMahon, 2005; Scritchfield, 2006; Brinckmann, Grichnik & Kapsa, 2010), some of the more prominent reasons why new companies succeed are hard work and dedication, pursuit of market demand for products and services, as well as adequate business planning (better forecast of yields, performance and business results).

During the decline stage, a company is provided with an opportunity to test its plans and strategies relating to cushioning crisis effects and assessing the time left to new expansion stage. Nevertheless, not many companies are able to launch themselves into a new expansion stage. According to (Cooper & Edgett 2010), cooperative strategies represent a very powerful tool for a company's development/expansion. According to this principle, several companies join forces in order to achieve a common goal. Companies work together in order to create a bigger value which, in turn, will lead to lower operating expenses than when a company is isolated on the market. Strategic alliance is a type of cooperative strategy where companies combine their resources and know-how in order to achieve competitive advantage, these alliances are very common when it comes to certain companies' limitations in terms of size, market share, and annual capital turnover or profits (Sharma, Chrisman & Chua, 1997; Walters, Priem & Shook, 2005). Sometimes, companies join forces in order to achieve greater success in risk management and avoid unwanted outcomes. This strategy is implemented in order to defend companies from risks and uncertainties as much as possible. SMEs implement such strategies when entering new markets or launching new products (Marino, Lohrke, Hill, Weaman & Tambunan, 2008).

3. DEFINITION OF RESEARCH PROBLEM

The existing literature overview does not offer answers to many questions concerning the life cycle of family SMEs. Therefore, the authors identified several issues that might represent the definition of the problems to be examined and subjected to empirical analysis:

- Main problems when founding a company,
- Obstacles for labor force professionalization and promotion of organizational structure,
- Main challenges in the process of professionalization and organizational integration,
- Main factors for expansion in founding stage and expansion stage,
- Analysis of a company's slide into decline/stagnation stage,
- Analysis of strategies and plans for fighting crisis.

Having in mind these issues, it is possible to define survey questions aimed at examining the accuracy of hypotheses presented in this paper. The main hypothesis in this paper, which can help us provide answers for the previously performed analysis of current state in family SME sector in Serbia, is:
"Most family companies in Serbia are in the decline stage of the life cycle, which results in layoffs".
It is possible to extract three auxiliary hypotheses, whose empirical confirmation would also prove the accuracy of the main hypothesis. They are defined in the following way:

H1.1 – Most companies in the decline stage of life cycle are newly-founded family firms (founded less than five years ago);
H1.2 – The most common strategy for exiting crisis (decline or stagnation stage in the life cycle) is laying off a certain number of employees;

H1.3 – A company's failure to initiate export, added to inability to launch new products and services, results in that company's entering the decline stage of the life cycle – and staying there.
The authors of this paper will use a sample in order to prove (in)accuracy of the main and auxiliary hypotheses.

4. EMPIRICAL RESEARCH

The authors of this paper designed a survey consisting of 20 questions aimed at helping them analyze the identified problem and examine all properties of the stages in family SMEs' life cycle. The survey contained closed-ended questions (where respondents had to opt for only one of the answers), as well as questions based on Likert scale (1-the least important, 5-the most important). The five introductory questions related to basic sample features, presented in Table 2. The respondents were contacted in three ways: via e-mail - by sending them an online questionnaire, via telephone and personal contacts (contacts provided by the Serbian Chamber of Commerce), who have later been provided with the survey, between February 2014 and April 2014. The overall potential number of respondents was 4.000. The sample contained excellent distribution throughout the territory of Serbia (reason for this kind of distribution is a large scale of economic differences between four regions of Serbia), with a satisfactory number of family firms (see Table 1).

Table 1: Regional distribution of enterprises

Region	Overall number of enterprises	%	Overall number of family enterprises	Sample used in this research
Belgrade region	38.093	44,0	30.475	584
Vojvodina region	23.487	25,2	21.180	256
Sumadija and West Serbia region	17.152	19,0	15.426	220
South and East Serbia region	8.871	11,8	8.327	94
Republic of Serbia	**87.603**	**100,0**	**77.608**	**1.154**

Source: Authors' data and statistical yearbook of the Republic of Serbia 2013

The number of respondents who successfully completed the survey was 1,154 (29% of the overall number of contacted companies).

5. RESULTS OF THE RESEARCH

Basic characteristics of the sample are presented in table 2. Most companies from the sample are micro businesses (up to 9 employees), while only 1,1% of surveyed companies have between 51 and 100 employees. The majority companies in the sample are service companies (58,7%), while others have production (13,5%), or combine services and production (27,8%). The owner of the company, in most cases (99%), is also its general manager.

Table 2: Basic characteristics of surveyed enterprises

Number of employees	***answer***	*1-9*	*10-20*	*21-50*	*51-100*	*101-250*
	percentage [%]	65,9	17,5	13,5	0,8	2,4
Annual income	***answer***	*less than 500.000 EUR*	*btw. 500.000 and 2mn EUR*	*btw. 2mn and 5mn EUR*	*btw. 5mn and 27mn EUR*	*no response*
	percentage [%]	42,1	17,5	16,7	9,5	14,3
Annual turnover	***answer***	*less than 1mn EUR*	*btw. 1mn and 5mn EUR*	*btw. 5mn and 27mn EUR*	*more than 27mn EUR*	*no response*
	percentage [%]	39,7	21,4	15,1	13,5	10,3

Main survey questions, as well as answers, are displayed in table 3.

Table 3: Research questions, answers and statistics

Question	Answer	Result (1-5; 0-100%)
what were the biggest problems during the establishment of the firm	identification of target audience for the company's products/services	2,92
	improvement of existing products/services in the company	2,88
After overcoming initial problems, what were the following experiences	A slight increase in the number of employees occurred	3,38
	A moderate increase in sales of goods/services occurred	2,79
Did the owners experience resistance to change	Yes, regarding professionalization and promotion of organizational culture	32,3%
What do the owners perceive as the way to decrease resistance to change	Improvements in organizational culture	52,3%
Did you fail to internationalize your operations after entering the decline stage	Yes	90%
What was the direct cause for your firm to enter the decline stage	Failure to expand goods/services portfolio	100% **(H1.3)**
After entering the decline stage, did you manage to further develop firm operations	No, failed	51%
How did you foster further development	By yielding a new cycle in production/services portfolio	43,7%
	By opening new job positions	26,2%
What had the biggest influence on your company's operations	Generation of new products/services	1,6%
	We never expanded our company goods/services portfolio	28%
What was your main strategy to combat business crisis	Lay- offs	41%
What was your vision for overcoming business crisis/decline stage (contingency plans) (multiple answers)	Lay-offs	48% **(H1.2)**
	Reengineering of production/services processes	50%
	By initiating new cycle of production	20%

Cross referencing of data, regarding decline phase and company period of functioning has been presented in table 4. It can be seen that most companies in the decline stage of life cycle are newly-founded family firms (founded less than five years ago), which directly confirms the first hypothesis **(H1.1)**;

Table 4: Question about decline/stagnation phase

		Company exists:			
Decline stage:		Less than 5 years	Between 6-9 years	Between 10-20 years	Over 20 years
Yes	81,5%	65,8%	15,3%	13,07%	5%
No	18,5%	34,2%	84,7%	86,9%	95%

All three hypotheses have been verified using available statistical methods, as presented in table 5.

Table 5: Testing of three auxiliary hypotheses

Test / Hypothesis		H1.1	H1.2	H1.3
Chi-square test	*Pearson Chi-Square*	12,792	111,123	35,797
	Likelihood Ratio	14,030	121,773	48,867
ANOVA (standard mean error)		0,041	0,742	0,064
Pearson Kendall-tau b coefficient		,080	-,505	-,501
Gamma coefficient		,133	-,619	-1,000

Source: Authors' data

The tests confirmed that hypotheses were correctly set, i.e. that their definition is an accurate reflection of surveyed state of family SMEs in Serbia. Chi-square tests examined the correlations between questions used to prove the hypotheses. T-test successfully examined sample deviations relating to probability of error in standard deviation, while coefficients (Pearson-Kendall and Gamma) tested the correlation between answers.

6. DISCUSSION ON RESEARCH RESULTS

In 2008, the global economic downturn caused potential investors to give up on Serbia; the country's export to CEFTA region, the EU and other markets dropped significantly. The main problem was the fact that the state failed to stop negative trends during 2009/2010. This downward trend had a devastating influence on the SME sector, since it represents 95% of all companies in Serbia. The lack of preparations for the crisis influenced Serbian economy and export – it is astounding to hear that more than 50% of surveyed companies (GfK survey encompassing 400 small and medium-sized enterprises in Serbia) haven't made any investments in their business during 2012, while 60% do not have investment plans for this year either. In 2013, the European Investment Bank (EIB) earmarked a EUR 318mn loan aimed at helping the Serbian SME sector.

One of the reasons for failing to diversify the range of products and services to a multinational level, can be the fact that family firms have no connections to big systems that can offer new markets and salvation to SMEs. This could be achieved if a small family business was to be a part of a big company's supply chain. According to data from Doing Business (issued by the World Bank), Serbia's rise on the list of world economies was very slow since the beginning of the global crisis (91st place in 2008, 90th place in 2009, 90th place in 2010, 89th place in 2011, 95th place in 2012, 87th place in 2013, 93rd place in 2014, 59th place in 2015). Since it was established that mostly small companies experienced the decline stage, the research clearly shows their strategies for combating the crisis. As much as 90% of surveyed managers in micro companies believe that letting go extra workforce is the best strategy. Another addition to the generally weakened state of the SME sector in Serbia is the fact that only 3% of surveyed companies have been implementing innovations in order to get to the diffusion stage. According to (Radonjic Petrovic, Jakopin & Ezdenci, 2009), only 9% of companies in Serbia have an innovation plan involving cooperation with other companies. Only 25% of companies is implementing innovation activities, while 30% of them introduced innovations in products/services or technological processes. As far as management's reaction to a company's entering the decline/stagnation stage is concerned, the paper examines strategies involving layoffs, whose goal is to restructure operations and reorganize the company. Reorganization, as a strategy for exiting crisis, can be performed by hiring new employees. Nevertheless, in this surveyed sample, only a small percentage of companies opted for this strategy. In addition, two strategies, also presented in this study, which can help companies survive the downward trend, are changes in market orientation, as well as changes in production/service provision. Other authors (Walters et al., 2005; Beaver, 2007) have also been examining these strategies and wrote about differentiation of products/services (new markets and approaches), as well as the strategy of cost effectiveness (reorganization of business operations). Nevertheless, contrary to the abovementioned authors (as well as authors of this paper), there are other interpretations regarding the strategies that should be dominantly used for mitigating the effects of the decline stage in a company's life cycle. One such example is a study written by (Verreynne & Meyer, 2010), that mentions a different approach to the creation of a business strategy for an SME. The uniqueness of this approach is the fact that there is no specific strategy for every stage in the life cycle – the company's management is in charge of securing participation in decision making, as well as encouraging the ability to adapt to external changes. This approach aims to decrease business risks and prevent the company from ever facing any problems. This study pointed to the possible causes (certainly not the only causes) for a company's slide into the decline/stagnation stage. In this phase the company is usually recording

unfavorable business results and/or has a lower production volume. The identified causes are: company's failure to cross national borders, as well as its inability to expand the range of products or services in order to avoid bad results caused by the declining sales of a single product/service. These conclusions are an excellent addition to the research performed by (Marino et al., 2008). According to them, the main causes of a company's bad business results are the lack of resources necessary to "combat" the environment, as well as failure to join forces with other similar companies in order to have better chances in the market game.

The authors have performed a series of tests on all three auxiliary hypotheses in order to confirm the validity and diversity of sample. Having in mind the limited reach of the study (family-owned businesses in Serbia), in case of positive reviews, the authors would be inclined to expand the research to all SMEs in Serbia; this research would, of course, imply a bigger sample and a wider analysis of life cycle factors.

7. CONCLUSION

This paper presents the characteristics of the decline stage in family businesses, as well as strategies for combating crisis and improving business activities. It also presents a good addition to existing studies, such as a research paper from (Mihic et al., 2015), where the authors conducted a family business research in Serbian SME sector, dealing with different impacts on business success. The main hypothesis of this paper has been successfully confirmed, on three auxiliary hypotheses that define it, i.e. hypotheses with a closer connection to the survey from this study. A future research, that could represent a quality addition to the present one, would involve observation and monitoring of surveyed companies over a period of several years in order to get a trend of indicators pointing to properties of certain life cycle stages. This would enable the evaluation of adopted strategies and generation of plans for exiting the decline/stagnation stage of the life cycle.

Acknowledgments

This paper is a result of the project no. 179081 founded by Ministry of education and science of the Republic of Serbia: Researching contemporary tendencies of strategic management using specialized management disciplines in function of competitiveness of Serbian economy.

REFERENCES

Abdesselam, R., Bonnet, J., & Le Pape, N. (2004). An explanation of the life span of new French firms. *Small Business Economics,* 23(3), 237-254.

Barbero, J.L., Casillas, J.C., & Feldman, H.D. (2011). Managerial capabilities and paths to growth as determinants of high-growth small and medium-sized enterprises, *International Small Business Journal,* 29(6), 671-694.

Beaver, G. (2007). The strategy payoff for smaller enterprises, *Journal of Business Strategy*, 28(1), 11-17.

Brinckmann, J., Grichnik, D., & Kapsa, D. (2010). Should entrepreneurs plan or just storm the castle? A meta-analysis on contextual factors impacting the business planning–performance relationship in small firms, *Journal of Business Venturing,* 25(1), 24-40.

Cooper, R., & Edgett, S. (2010). Developing a product innovation and technology strategy for your business, *Research-Technology Management,* 53(3), 33-40.

Dodge, H.R, & Robbins, J.E. (1992). An empirical investigation of the organizational life cycle model for small business development and survival, *Journal of Small Business Management,* 30(1), 27-37.

Franks, J., Mayer, C., & Volpin, P. (2011). The Life Cycle of Family Ownership: International Evidence, *Journal of Financial Studies*.

Graafland, J., van de Ven, B., & Stoffele, N. (2003). Strategies and Instruments for Organizing CSR by Small and Large Businesses in the Netherlands, *Journal of Business Ethics,* 47(1), 45-60.

Headd, B., & Kirchhoff, B. (2009). The Growth, Decline and Survival of Small Businesses: An Exploratory Study of Life Cycles, *Journal of Small Business Management,* 47(4), 531-550.

Herbane, B. (2010). Small business research. Time for a crisis-based view. *International Small Business Journal*, 28(1), 43-64.

Johnsen, G.J., & McMahon, R.G.P. (2005). Owner-manager Gender, Financial Performance and Business Growth amongst SMEs from Australias Business Longitudinal Survey, *International Small Business Journal,* 23(2), 115-142.

Jovanovic, P., Petrovic, D., Mihic, M., & Obradovic, V. (2012). Necessary Skills of Managers in Transition Countries – The Case of Serbia, *TTEM*, 7(2), 631-637.

La Rocca, M., La Rocca, T., & Cariola, A. (2011). Capital structure decisions during a firm's life cycle, *Small Business Economics*, 37(1), 107-130.

Marino, L.D., Lohrke, F.T., Hill, J.S., Weaver, K.M., & Tambunan, T. (2008). Environmental Shocks and SME Alliance Formation Intentions in an Emerging Economy: Evidence from the Asian Financial Crisis in Indonesia, *Entrepreneurship Theory and Practice,* 32(1), 157-183.

Masurel, E., & van Montfort, K. (2006). Life Cycle Characteristics of Small Professional Service Firms, *Journal of Small Business Management,* 44(3), 461–473.

Mihic, M., Arsic, S., & Arsic, M. (2015). Impacts of entrepreneurs' stress and family members on SMEs' business success in Serbian family-owned firms, *Journal of East European Management Studies*, 20(4), 452-483.

Muhlbacher, J., Nettekoven, M., & Kovac, J. (2011). Competency management in Slovenia. Paradoxes between development trends and drivers of change, *Journal of East European Management Studies,* 16(1), 75-90.

Peiser, R.B., & Wooten, L.M. (1997). Life cycle changes in small family businesses, *Business Horizons,* 26(3), 58-65.

Radonjic Petrovic, D., Jakopin, E., & Ezdenci, I. (2009). MSP report, Retrieved from http. // www.merr.gov.rs.

Rutherford, M.W., Muse, L.A., & Oswald, S.L. (2006). A New Perspective on the Developmental Model for Family Business, *Family Business Review,* 19(4), 317-333.

Scritchfield, R.L. (2006). Life cycle planning for the small business owner, *Life & Health Financial Services,* 110(34), 20-22.

Sharma, P., Chrisman, J.J., & Chua, J.H. (1997). Strategic Management of the Family Business, Past Research and Future Challenges, *Family Business Review*,10(1), 1-35.

Sharma, P., & Salvato, C. (2011). Commentary: Exploiting and Exploring New Opportunities Over Life Cycle Stages of Family Firms, *Entrepreneurship Theory and Practice,* 35(6), 1199-1205.

Smithson, J. (2004). *Role of the Non-Executive Director in the Small to Medium Sized Businesses (1st ed.).* Gordonsville: Palgrawe Macmillan, 1-203.

Verreynne, M.L., & Meyer, D. (2010). Small business strategy and the industry life cycle, *Small Business Economics*, 35(4), 399-416.

Walker, E., & Brown, A. (2004). What success factors are important to small business owners, *International Small Business Journal,* 22(6), 577-594.

Walters, B.A., Priem, R.L., & Shook, C.L. (2005). Small business scanning stages and the dominant logic of the business level strategy, *Journal of Small Business Strategy,* 15(2), 19-32.

ARGUMENTS FOR DESIGNING PROGRAMMES FOR ENCOURAGING THE YOUTH IN SERBIA TOWARDS ENTREPRENEURSHIP

Jasmina Omerbegović-Bijelović*[1], Predrag Mirković[1], Zoran Rakićević[1]
[1]Faculty of Organisational Sciences, University of Belgrade
*Corresponding author, e-mail: omeja@fon.bg.ac.rs

Abstract: *This paper points out a way to help with solving the high levels of unemployment amongst the young in Serbia – by designing and realising programs which would allow their inclusion in the entrepreneurial waters - either self-employment and/or employment of others. The idea is to identify and recommend to stakeholders competencies and motives driving the young entrepreneurs nowadays – as models for enabling and motivating unemployed youths to engage with the entrepreneurial world. On the basis of facts obtained by research – which pinpoint the competencies - both practical and theoretical - and the motives of the young entrepreneurs in Serbia, as well as on the basis of their beliefs/attitudes about the same aspects of starting and undertaking entrepreneurial projects, some recommendations have been generated for designing programs to encourage those young people to join the ranks of entrepreneurs. That which remains is for the relevant authorities - in the legal and even family settings, i.e. all those who can recognise some self-interest, to get started and dedicate themselves to the young and their entry into the world of entrepreneurship. The contribution of this paper is in the packages of suggestions for the different types of stakeholders which would help them design programs to bring the young generations into the entrepreneurial sphere. We also consider useful even the very fact of pointing out the different roles of the various social subjects/stakeholders in bringing the young in Serbia into the world of entrepreneurship, as a form of care for the young generations.*

Keywords*: young of Serbia, competencies for entrepreneurship, motives for entrepreneurship, programmes for encouraging the young towards entrepreneurship*

1. INTRODUCTION

From the second half of the 20th C there is an increased "piling up" of young people in the unemployed category. The sudden world population growth (and therefore the numbers of young people too) as well as the growth of better equipped and more automated workplaces, ICT and standardisation, have brought about a relative decrease in the number of available work places (especially in the area of production) – measured in percentages (as seen against the overall number of people in the world). The migration of capital (especially to Asia) has caused, especially in the highly developed parts of the world, the "extinction" of big parts of industries (like the automotive industry of USA, for example). Although the service sector has been developing quickly, it has not proven capable of absorbing the entire excess of the workforce so that, for decades now, the period of waiting for one's first job is extended and there is a growing "unemployed army".

Serbia is also a part of this "trend" where the young, for decades now, increasingly have to wait to find a job and their numbers (those unemployed) in the employment centres just keeps – growing; that can be seen both in absolute terms and in relation to the overall population numbers. Unemployment rate in Serbia 2013 was 22.1%, according to World Bank Indicator; in 2014 was 18.9% (Labour Force Survey, 2014).

It is for that reason that the theme of this paper is connected to the idea of solving the problem of youth unemployment in Serbia: 49.4% for total labour force ages 15-24, according to World Bank Indicator (2013). The idea is to encourage the youth to greater inclusion in the world of work and business – through entrepreneurship – both by self-employment and the employment of others. Namely, although it may be possible to solve the above stated problem in other ways, it may be worth bearing in mind that 2016 was voted the *Year of entrepreneurship in Serbia.* We attempt to contribute to the solving of youth unemployment problem through the use of "entrepreneurial climate support". As the climate on its own is not enough, we point out in this paper that anyone who is truly interested (stakeholders) in solving the youth unemployment problem must begin with a serious, systemic and systematic, work to address the problem.

Entrepreneurship can be defined as the process by which individuals follow opportunities without regard to resources they currently control, and as "art of turning an idea into a business" (Barringer & Ireland, 2010, p. 30). Entrepreneurs recognize opportunities (i.e. discover market needs as opportunities) and turn them into

successful businesses (launch new firms to meet those needs) (Hsieh et al., 2007; Moore et al., 2008, p. 6). According to Omerbegović-Bijelović (2010, p. 234), entrepreneurship can be defined as "a social function of creating new values through the creative combination of business resources". Zampetakis et al. (2013) claim too that entrepreneurship is linked with the value creation, and has a significant impact on economic growth and employment. Due to the fact that entrepreneurial activity is a key engine of economic growth, promoting youth entrepreneurship has become a priority for policymakers throughout the world (Sobel & King, 2008). Kasim et al. (2014) review global trends and practices from past research on regenerating youth development through entrepreneurship, listed existing youth empowerment programs, marked major stakeholders for this issue, and give some interesting prepositions. Sobel & King (2008) found positive influence of school voucher programs (government funds for school tuition and expenses) on a rate of youth entrepreneurship.

In solving the problem of youth unemployment in Serbia there are the following "interested parties" (stakeholders): the State and the ministries (above all: Ministry of Education, science and technological development, Ministry or commerce, Ministry of work, Ministry or youth and sport, Ministry of culture), Local communities, Businesses and institutions (at least national ones), Family businesses (owners and their progeny), Media, Other stakeholders (Banks, Youth organisations, Employment centres…). All of them could give support by desisting with the "firing strategy" and instead started the "strengthening internal/corporative entrepreneurship" (with the understanding that they have a lack of ideas and not an excess of employees) and "everything that is not a core competency should be outsourced" strategy (which would in turn create a "business satellites orbit" for "excess"/experienced workers, as well as for young entrepreneurs/employees).

Every one of them could generate a package of their own strategies for helping with the unemployment problem (including youth unemployment which is the main focus of this paper) in which there would unfailingly be different ways of support for future youth entrepreneurs. In that way, for example, every stakeholder in the employment of the young through entrepreneurship could create their own "package of recommendations", i.e. The Programme for encouraging the young (in Serbia) to take up entrepreneurship. (It would be especially good if their activities could be coordinated – which would avoid one-sidedness in allowing the young generations to truly utilise all their potential.)

In designing such programmes, every stakeholder, as a good manager, ought to start with establishing the current status in the area of youth entrepreneurship: the number of young entrepreneurs, their competencies and motives etc. One should also bear in mind the circumstances for that particular entrepreneurial branch: the structure of needs, opportunities for including the young and their companies, availability of resources to those youths and their companies, available and needed support to young entrepreneurs... Also, it would be useful to tie in projections of the social/state development with roles of young entrepreneurs.

The idea is to create the basis of programmes (meta-programme) to support youth entrepreneurship - in Serbia and elsewhere. It - the basis - could be seen as a meta-programme for creating programmes to support youth entrepreneurship, applicable everywhere - in every country and for every stakeholder. The other aspect of this idea has to deal with the uniqueness of stakeholders, especially bearing in mind national characteristics; they should be offered examples/suggestions of stakeholder's programmes or, at the very least, some ideas for their content - to stimulate youth entrepreneurship.

This idea is intended for "the group of stakeholders who support (would like) some change in the entrepreneurial spirit": the State and its ministries (of: education, commerce, youth, as well as the culture ministry and others!), local and organisational communities (supply/value chains and networks, business incubators/hubs and parks, clusters etc.), companies and institutions, family businesses (especially the owners and their heirs!), media and other stakeholders (banks, youth organisations, job seeking institutions).

The intention is for the stakeholders to be inspired to design their own programmes for encouraging the young to entrepreneurial efforts (including through cooperation with a specific stakeholder). For that they need a meta-programme, examples and/or ideas for the design of the Programme as well as their own decision (if they can recognise their self-interest). Through the observed stakeholders it would be possible to obtain some sort of national consensus for the fight against youth unemployment and for their introduction to entrepreneurship and the world of work, i.e. it would be possible to promote and spread the entrepreneurial spirit/culture further.

2. THE IMPORTANCE OF INCLUDING THE YOUTH IN SERBIA IN ENTREPRENEURSHIP

Long term benefits of promoting entrepreneurship among young in Serbia are presented in (Hutchinson et al. 2012): Creating employment opportunities for young entrepreneur and they future employees; Involvement of youth marginalized groups into economic flow; Helping youth develop new skills, knowledge and experiences that can be applied to various challenges in life; Promoting the recovery of the local community especially those that are rural; Capitalizing on the fact that young entrepreneurs may be particularly responsive to new economic opportunities and trends.

Apart from the stakeholder side of solving unemployment, it is also important to become aware of the interests of the young. They, in the here and now, choose long term career plans, but also to make families (and the number of children in the future), to deal with their housing situation (and to enter into a long term debt for it!), to "look after their parents" in their old age, as well as to further educate themselves, to name just a few.

For that reason it is important to understand what keeps them here - in Serbia - and what they find discouraging (i.e. regarding jobs and entrepreneurship). It is important to understand how to best help them in making their dreams a reality, as well as to work out how to bring the societal needs for implementing the latest scientific findings into the field of vision of the young, in order to encourage those young for entrepreneurship in those -creative, promising and profitable industries/fields. (In closest connection with that we find the educational-development perspective of the young generations and therefore some new demands ahead of the educational system itself - in which it is important to create curious, flexible, wise yet enterprising workers, entrepreneurs and managers).

The young should be made to feel closer to the work culture as well that of entrepreneurship. If we could alter the view of Work as something that is compulsory, that must be done ("a fight against Nature", if you will) to a view of Work as the normal state of healthy people - who work with and coexist with the Nature, it would increase the understanding of the need for adjusting work circumstances, it would strengthen the desire and readiness to "play" different roles in business systems and also for life long personal (and collective) development. Such a community would surely "dream" of changes, improvement, development... It is to be expected earnings that such a culture and such relationships could ensure a value system which would guarantee a permanent survival.

It is for that reason that it is important, right now, for all subsystems of the State to start to work on their own, publically announced and transparent promotion of the value system and on their own contributions to that very system. Entrepreneurial young people are, even as we speak, keenly following what goes on in their surroundings, where it all leads to and where there is a place for them; they are surely willing to share their observations with their environment and contribute to its promotion.

3. RESEARCHING THE COMPETENCIES AND MOTIVES OF YOUNG ENTREPRENEURS OF SERBIA

Motives for starting business and entrepreneurship might be influenced by many factors. Papulová & Papula (2015) have been sumarized motives into four groups. 1) Motives that are connected to profit - entrepreneurs interests in gaining an economic effect on the basic of their work; 2) Professional self-realization and emotional motives (non-motiveted by profit directly) - people that are professionals in certain area which want to gain a full satisfaction without managers limitations. Also these motives can be linked with emotions and effort to achieve something. 3) Social motives – in passive economic regions entrepreneurs can be motivated to create jobs for others, family, relatives, friends. 4) Motives which are result of external stimulations - through funding programs of local authorities, states, European Union, business agency. Besides motives for entrepreneurship, Robles & Zárraga-Rodríguez (2015) explore with Delphi method the next key individual competencies of entrepreneurs: risk assumption, initiative, responsibility, dynamism, troubleshooting, search and analysis of information, results orientation, change management and quality of work.

In order to solve the problem of youth unemployment (of Serbia), we suggest they be guided towards entrepreneurship. Youth entrepreneurship is a practical application of entrepreneurial characteristics of young people, such as initiative, innovation, creativity and risk taking in a working environment (either self-employment or work in small enterprises), using appropriate skills (Delgado, 2004, p. 99).

According to Nabi et al. (2010), higher education reduces the likelihood of entrepreneurship. Opposite to this,

Zhang et al. (2013) state that relationship between high education and entrepreneurship is positive. Solesvik et al. (2013) showed that there is positive relation between entrepreneurship education and entrepreneurial intention. Farashah (2013) differ tree types of entrepreneurial education: learn to understand entrepreneurship, learn to act in an entrepreneurial way and learn to become an entrepreneur. Vilcov and Dimitrescu (2015) analysed entrepreneurship education and the development of entrepreneurial competencies of young people in Romania. They concluded that entrepreneurial education leads students to understand daily life problems, helping them identify and assess the consequences of personal decisions.
From the research presented in Roberts (2008), the most common sources of different forms of support for young entrepreneurs comes from entrepreneur's close environment. Primarily, family of young entrepreneurs is the main source of support (71% of support comes from the family). After that, 20% comes from close friends. Unfortunately, modest share came from banks, the state and other organisations.

Into creating a favourable entrepreneurial environment, for growing the spirit of entrepreneurship, the already mentioned stakeholders are required (the State and its ministries, companies, institutions etc.). The idea is that they could create their own programmes for encouraging the young to enter the world of entrepreneurship - bearing in mind their own interests too. Those programmes should be in accordance with the missions (and the visions) of stakeholders and be relevant to including the young into the waters of entrepreneurship.

Bearing in mind the publically proclaimed and available missions of all categories of viewed stakeholders, what remains is to ask the young about their idea(s) of entrepreneurship. Following on from that, it should be possible to start generating recommendations for programme designing - and for generating the meta-basis for programme creation and the specifics for stakeholder programmes to encourage youth entrepreneurship.

3.1 Research methodology

In the aim of checking the idea about the possibility of designing set of stakeholders' programmes for encouraging youth entrepreneurship, in addition to an overview of theoretical achievements, circumstances related to making the idea come true and the specific missions of individual stakeholder categories (which all is not within the purview of this paper), it is also important to become acquainted with the experiences and views/motives of today's young entrepreneurs. They need to show and evaluate their own experiences and motives, pointing out the acceptable and unacceptable aspects of behaviour towards young entrepreneurs they have themselves experienced.

For this purpose we have generated the basic/general hypothesis H(0): It is possible from young entrepreneurs in Serbia to find out about the competencies (knowledge/theory and experience/practise) and the motivation which the youth of Serbia requires for self-employment (being included in entrepreneurship).
From this, we have deduced two specific hypotheses:

- The specific hypothesis H(1): It is possible from young entrepreneurs in Serbia, to find out about the competencies for the youths (in Serbia) which would make self-employment possible (and becoming entrepreneurs in the process).

This specific hypothesis further divides into two individual hypotheses:

  - H(1;1): It is possible from young entrepreneurs in Serbia, to find out about knowledge/theory for the youths which would make self-employment possible (and becoming entrepreneurs in the process).
  - H(1;2): It is possible from young entrepreneurs in Serbia, to find out about experience/practice for the youths which would make self-employment possible (and becoming entrepreneurs in the process).

- The specific hypothesis H(2): It is possible from young entrepreneurs in Serbia, to find out about motives which direct and drive the youths (in Serbia) towards entrepreneurship.

Therefore, the basic hypothesis H(0) was deconstructed into three individual ones (as in Figure 1): H(1;1), H(1;2) and H(2). All three will be tested through field research, using questionnaires - with between 8-32 research based questions per individual hypothesis. The special hypothesis H(1) and the basic/general one H(0) will be induced – from the lower hypotheses.

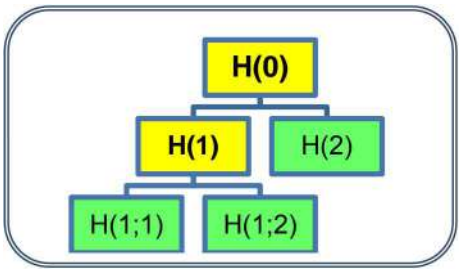


Figure 1: The hypotheses structure

For this occasion we made a considerable questionnaire about the competencies (theoretical knowledge and experience from practice) as well as the motivation for embarking into the world of entrepreneurship. The questions were grouped by areas: about the subject (16 questions), the subject's company (9 questions), experience with learning about and becoming enabled for entrepreneurship (32), attitudes in learning about entrepreneurship (11), experience in becoming motivated for entrepreneurship (9) and attitudes for becoming motivated for entrepreneurship (8 questions). The questionnaire contained altogether 85 questions.

The sample group participants who filled out the questionnaire consisted of 35 young entrepreneurs in Serbia. The research was conducted 2016 in Serbia. Filling out the questionnaire was done electronically.

3.2. Research results and discussion

The basic data on the (mostly young) entrepreneurs of Serbia (Table 1) prevail men (58% of the sample), highly educated (86.2%), the founders of the companies (50%), with experience in entrepreneurship (80%), with no formal education for entrepreneurship (38.8+25=63.8%) - or with a permanent (or non-formal) education (for entrepreneurship and management), a former high school students (58.3%), with the entrepreneurial tradition in the family (63.9%) and with entrepreneurs in the region (88.9%) . They are (Table 2) aged of 28.31 years (Mean (M)=28.31; Std. Deviation (SD)=5.89), with 0.75 based companies, average (M=0.75; SD=0.69).

Table 1: The attributes structure of the survey sample with frequencies of categorical variables (Part 1)

N°	Categorical variables about respondents		Percentage
1	*Respondent's gender*	Male	58.0 %
		Female	48.0 %
2	*Respondent's education*	Bachelor degree	55.6 %
		Master degree & PhD degree	30.6 %
3	*Position in company*	Founder	50.0 %
		Successor	36.1 %
		Employee	13.9 %
4	*Entrepreneurial experience*	Yes	80.0 %
5	*Entrepreneurial education*	Without education	38.8 %
		Courses and seminars	25.0 %
6	*Finished secondary school*	Grammar school	58.3 %
		Schools of economics	13.9 %
7	*Family tradition for entrepreneurship*	Yes	63.9 %
8	*Any entrepreneur in your surrounding?*	Yes	88.9 %
9	*Do you continually educate while employed (for entrepreneurship and/or for management)?*	Formally	42.4 %
		Informally	51.5 %
		Both	6.1 %

Table 2: The attributes structure of the survey sample with frequencies of categorical variables (Part 2)

	Scale variables	Mean (M)	Std. Deviation (SD)
1	*Respondent's age*	28.31	5.89
2	*The number of established enterprises*	0.75	0.69

Information about companies in which respondents work (Table 3) show that 91.7% of respondents work in their own or in a family business (other more "apprenticeship" in other people's businesses), and 66.7% of these enterprises are in Belgrade; the most common type is "Ltd" (58.3%) and mainly is engaged in the provision of services (13.9+36.1=50%). The majority (77.7%) are micro-enterprises - including

entrepreneurial shops, agencies and the others, with average of 11.34 employees (M=11:34; SD=8.15). They are mainly (Table 4) older than 1 year (83.3%), with 52.8% in the phase of ascent/rising (Table 3).

Table 3: The attributes structure of the survey respondents' enterprises

N°	Categorical variables about respondents' enterprises		Percentage
1	*Business owner*	Respondent	50%
		Respondent's parents	41.7 %
2	*Location*	Belgrade	66.7 %
3	*Enterprise type*	Limited liability company	58.3 %
4	*Activity*	Services	36.1 %
		Mostly services	13.9 %
5	*Enterprise size*	Micro enterprise	44.4 %
		Entrepreneur	33.3 %
6	*Enterprise life cycle*	Climbing phase	52.8 %

Table 4: Statistical data about the number of employees in the enterprise

Scale variables	Mean (M)	Std. Deviation (SD)
The number of enterprise employees	*11.34*	*18.15*

The experiences and recommendations on theoretical knowledge of entrepreneurial ventures and the establishment of enterprises, according to the sample of young entrepreneurs of Serbia, are given in Table 5. It can be seen that, since high school, they got and they expect that other young people should also be taught discipline and work habits – which is, as one of the three most important areas of high school education, from comprehensive list of authorities, elected by 39% respondents. The following are general knowledge/culture (25%), ICT (25%), and then the knowledge of the business and others; that indicates further that of the (compulsory) high school practices they get exploring business (18%) and manufacturing/service process (15%), learning about the proper attitude toward customers/clients (13%) and others. Young people are recommended a gradual entry into professional life - through the general living and scientific knowledge and through practice that introduces them to the basic flow - when it comes to high school education.

Table 5: Relevant entrepreneurial knowledge types and practice

N°	Frequencies of respondents' answers		Percentage
1	*Important secondary school knowledge for entrepreneurship*	Discipline and work habits	39 %
		General Knowledge (from general culture)	25 %
		Information and communication technology	25 %
2	*The most useful knowledge from Secondary school practice*	Exploring business process	18 %
		Exploring of production / service process	15 %
		Exploring customer/buyer relationship	13 %
3	*Important academic knowledge for entrepreneurship*	Marketing and sales	27%
		Finance and Accounting	24%
4	*The most useful knowledge from faculty practice*	Verification of theoretical knowledge	21%
		Exploring the own preferences	12 %
		Exploring the business process	12 %
5	*The most important entrepreneurial know-ledge and skills after starting business phase*	Operations management (operations and reso- urces in manufacturing and service delivery)	64 %
		Human resources	50 %

From University institutions, in the start-up phase of entrepreneurial ventures, mostly appreciate and expect from youth (Table 5), training (theoretical knowledge) to engage in marketing (27%) and finance (24%), while from the practice in Universities, as most important, they recognize and expect for young people: the verification of theoretical knowledge (21%), Introduction to their own preferences/interests (12%) and Introduction to business processes (12%). When a company exists, young entrepreneurs realize that the competitiveness of the work depends on the knowledge and skills in all positions, but expect the competence to manage the operational function, operations management and resources management in producing and servicing (64%), followed by the Human Resource Management (50%), and by the other functions.

Table 6: Respondent opinions about knowledge of entrepreneurship

N°	Frequencies of respondents' answers		Percentage
1	*Entrepreneurship in teaching programs of primary and secondary schools*	Yes	91.2 %
2	*Method of education for entrepreneurship*	School + Practice	22.9 %
		School + Practice + Media+ Different informal ways of education + Entrepreneurial culture in society	37.1 %
3	*The most important entrepreneurial knowledge and skills in starting a business*	Identifying business opportunities	64%
		Creating a business plan	50%
		Recognition / generate business ideas	42%
		Determining market potential of entrepreneurial ideas (planning and price range)	42%
		Providing money for the founding costs	33%
		Planning of providing staff	31%
4	*Is there a need for training of future entrepreneurs?*	Yes	94.4%
		No	5.6%
5	*The cooperation with young entrepreneurs will be useful for future entrepreneurs*	Yes	97.2%
		No	2.8%

The idea of introducing the subject Entrepreneurship in primary and high schools (Table 6), respondents support (91.2%), where as a method of education for entrepreneurship they choose combination of "School+ Practice+Media+Various informal methods of education" (37.1%); the first variant is the next "School+ Practice" (22.9%). When they were asked about the most important entrepreneurial knowledge and skills for starting to work, they choose (Table 6): Business opportunities identification (64%), Preparation of the business plan (or, at least, Co-operation in preparation…) (50%), Recognition/generating entrepreneurial ideas (42%), Determination of market potential of entrepreneurial ideas (42%), Providing money for the founding costs (33%), Planning security staff (31%) and the other - in descending order. For the family support in preparing future entrepreneurs "voted" 94.4% of respondents, and that the help of young entrepreneurs for future entrepreneurs is welcome agreed 97.2% of respondents.

Table 7: The attributes structure of the survey sample about motives for entrepreneurship

N°	Categorical variables about motives for entrepreneurship		Percentage
1	*Motives for entering entrepreneurship*	Realization / Approving own ideas	44%
		Inheritance (preservation of family tradition)	31%
		Self-employment	28%
		Earnings / Money	19%
2	*Do you have any role models while you are engaging in entrepreneurship?*	Yes	82.4%
		Successful entrepreneurs	47%
		Family members	39%
3	*How entrepreneur in your surrounding motivates you*	Motivated me to start discovering business opportunities and ways to use them	50%
		Aroused my interest in business, economicy activities, ractice	33,3%
4	*Do you think that young people should be involved in entrepreneurship?*	Yes	97.2%
		No	2.8 %
5	*If the previous answer is YES, tell the right time for it?*	During studies (20-25 years)	33.2%
		During high school (16-20 years)	27.1%
		After studies (25-30 years)	21.3%
6	*Do you think that young people should be motivated to entrepreneurship?*	Yes	100 %
7	*If the previous answer is YES, tell the right time for it?*	During high school (16-20 years)	52.9%
		During his studies (20-25 years)	32.3%
8	*What can motivate young people for entrepreneurship?*	Independence (in work and / or living by their own	53%
		Earning (money)	50%
		Gaining experience / Skills / Competencies	36%
		Companionship (expanding circle of acquaintances, enrichment intelligence ...)	36%
9	*What do you consider as the reasons for their entrepreneur dissatisfaction of their enterprise / company?*	Lack of support / help	30%
		Low profits	25%
		Lack of preparedness / capability	25%

Talking about their own experiences/characteristics, respondents from the sample represent the status of youth entrepreneurship in Serbia; their attitudes provides arguments for the design of educational programs (and theoretical and in practice) for the introduction of entrepreneurship into the new generation of young people (not only Serbia). The possible use of information about the experiences and attitudes of the respondents (the theoretical training and on the practice) is to generate/design programs prepare young people for the introduction of the entrepreneurship confirms individual hypotheses H(1;1) - the theoretical knowledge and H(1;2) - Education through practice. This might suggest that it is certified by the hypothesis H(1) – the possibility of obtaining data for future programs for preparing youth to enter entrepreneurship.

In order to test the H(2) - the young entrepreneurs from Serbia we can get arguments about the motives and motivation for entrepreneurship, useful in planning/designing programs to prepare young people - future entrepreneurs, some questions were asked and some answers were received - shown in Table 7. From there, we can see that young people are mostly motivated to achieve/prove their own ideas (44%), and (in Serbia in 2016!) to preserve the family tradition (31%) and more. They have "entrepreneurial idols" (82.4%), and most often successful entrepreneurs (47%) and family members (39%). The environment motivates the discovery of business opportunities and ways to take advantage of those (50%) and arouses interest in jobs, economic activities and practices (33.3%). They find that young people should be involved in entrepreneurship (97.2%) during the study (33.3%) high school (27.1%) and business doing (21.3%). Everybody (100%) agrees that young people should be motivated for Entrepreneurship: During high school (52.9%), during the studies (32.3%), but also in other age groups. The most successful "tools for motivating" consider: autonomy (53%), earnings/cash (50%), gaining experience/knowledge/competence (36%) and socializing (26%). They warn to the danger of discouraging (the reasons for their dissatisfaction entrepreneur's venture/enterprise), which stand out: lack of support/assistance (30%), lack of preparedness/ capability (25%) for entrepreneurship (and management - in the later stages of the development of entrepreneurial ventures) and low profit (25%).

Based on the results (Table 7), it is possible to recognize and use the arguments for designing programs to encourage young people to get involved in entrepreneurship - in terms of their motivation in ways that they consider most suitable or the most appropriate. In this regard, the hypothesis H(2) can be considered as proven.

As hypotheses H(1) and H(2) are established, the general hypothesis H(0) can be regarded as proven.

4. ARGUMENTS FOR DESIGNING A PROGRAMME FOR ENCOURAGING THE YOUNG TOWARDS EMBARKING ON THE ENTREPRENEURIAL PATH

Concluding on the basis of the provided answers (to the research questionnaire described in the above text), the general hypothesis H(0) was proven. However, as only Practise can be considered the highest form of criterion when it comes to truth, we point out some examples of the application of the developed arguments from the given research for designing and constructing the Programme for encouraging the young (in Serbia) towards entrepreneurship; this, in a practical sense, proves the hypothesis H(0).

As was claimed, it is possible to quote (only some of) the facts and recommendations for the Programme (meta-programme):

1. The young should be enabled entry into the world of entrepreneurship through the development of their competencies (knowledge and skills);
2. Entrepreneurial knowledge to be transferred using both theory and practise (through developing skills and gaining experience);
3. Family and the environment play a significant role in the fostering of and enabling one for the entrepreneurial approach;
4. The young expect the entire society (the State, enterprise, media) to be supportive of entrepreneurship...

In addition to this, every one of the stakeholders could specify their own elements of his Programme. Below are given some examples of the programme elements they might generate:

The State: on the level of the State it would be possible to (as expressed by the entrepreneurs who completed the questionnaire):

1. Create a National programme for the creation of the "entrepreneurial climate" (promotion and support of entrepreneurship);

2. Ensure a well planned-out, affordable support for SMEs, lasting the entire life cycle and support for entrepreneurs;
3. Use the media at the State level (public media, Internet, distance learning tools etc.) for affordable dissemination of new and relevant knowledge to the SME and Entrepreneur sectors (SMEE);
4. Create a network of local centers for the support of SMEE – in which they could meet and exchange experiences;
5. Create opportunities for young entrepreneurs to work with potential entrepreneurs ("peer support")(Table 6, Point 4: "Yes" was the response by 97.2% of the questionnaire participants!), creating opportunities for work and success;
6. Create and make publically available the long term plans (and strategic) development of the State – as an orientation guide for entrepreneurs;
7. All the participants agree that the youth need to be motivated towards entrepreneurship (T7, P6)...

The Ministry of Culture: Since culture is, according to the "Metamanagement" concept (Omerbegović-Bijelović, 1998), seen as the highest form of management, it is hereby given some very important tasks:

1. The promotion of the entrepreneurial culture, of work and the responsibility for one's own position in society (T7, P2);
2. The awakening of the interest of the young for work, commerce and practise... (T7, P3);
3. To show entrepreneurship in the context of becoming self reliant, freedom of choice, gaining competencies (experience and knowledge), socialising (meeting others, enriching one's intelligence...) – according to (T7, P8);
4. To inform the young about the latest scientific findings and their implementation (T7, P3)...

The Ministry of Education: Since this ministry is in charge, together with the Ministry of youth and sports, of solving the problems of the youths, there are numerous possibilities for them to be involved with the promotion and support of entrepreneurship:

1. In the educational programmes – include curriculum for entrepreneurship – for all ages (from kindergarten to post doctoral studies) – according to (T6, P1), (T6, P5), (T5, Ps1,3,5...);
2. The theoretical education programmes for entrepreneurship should be made relevant to the age of the students, the overall climate, local communities, culture... (which can be seen in several Tables: 1, 5, 6, 7);
3. Entrepreneurship is also learned through school practise (dual education) with the proviso that it should be planned out (with a clear task for the student and with mentors in both the institution doing the teaching and the insitution in which the pratical experience takes place) – on which there is more information in both the tables and the original data;
4. From the exhibited tables it can be seen that there are different areas of knowledge which needs to be taught to the young – depending on their age and life cycle phase of their company (it is interesting that, after the very first steps in entrepreneurship, the educational needs tend to focus on specific work related functions: operations (64%), human resources management (50%) etc. (T5, P5);
5. In the knowledge of entrepreneurship different themes have a different level of importance (hence "recognising the business opportinuty" was seen as paramount by 64% of the participants, according to T6, Ps2-9...

Media: They could (if they are at all entrepreneurial themselves and able to recognise a business opportinuty) to aid greatly the promoting of entrepreneurship nad entrepreneurial culture, either on their own or networked with other stakeholders of encouraging the young towards entrepreneurship in many ways:

1. By developing entrepreneurship induction programmes (for primary and secondary school pupils, for students and for already proven entrepreneurs), by following entrepreneurial undertakings... (T6, P6);
2. Together with the ministries of education, work, commerce and culture, they could help the spread of the entrepreneurial culture (and every other culture worth promoting) as well as pointing out the successful examples and lessons to be learnt from entrepreneurs who were less so, as well as spreading the knowledge and the drive to learn and work;
3. They could accept and maintain programmes (of life-long) long distance learning in the area of entrepreneurship – thus ensuring their own relevance, interactivity and availability...

Parents: The owners of the companies can also draw conclusions from the conducted reasearch and the available take, which would enable them to:

1. Prepare their own successors (in family run businesses), especially bearing in mind the fact that the young in Serbia care deeply about family tradition (Tab. 7, P 1,2);

2. Define the contents and the ways of preparing the young through a combination of environment programmes and "family programmes";
3. Ensure the survival of the family business by directing the creativity and enthusiams of their heirs and successors towards the areas which are of significance to the family business;
4. Find areas of entrepreneurship which are compatible with the personality of the (future) family business heirs...

The remaining stakeholders in encouraging the young towards entrepreneurship have their own (and/or common) "packages of specific programme recommendations, which are deliberately left out here (for space and scope reasons).

The above examples, again – in practise, confirm the general hypothesis H(0).

5. CONCLUSION

This paper has pointed out the possibility of solving the problem of youth unemployment (not only in Serbia!) by way of encouriging those youths towards entrepreneurship. It has been shown that today's young entrepreneurs (with their experience and their views) can contribute towards a better understanding of the needs of the young for entrepreneurial competencies (for theory/knowledge and experience/skills), as well as towards better understanding the motivation which drives the young towards entrepreneurship in the first place. We have also shown the dynamic of the above needs (eg. According to the life cycle phases of the entrepreneurial undertakings, but also according to the age of the „entrepreneurial candidate").

We have also pointed out the different stakeholders of entrepreneurship culture spread, as well as the possibility for tchem to apply a Programme (a meta-programme) for encouraging the young to become entrepreneurs; we also make a suggestion that in the proces they further complete it by generating their own, specific, stakeholder requirement programmes – according to their own interests and circumstances. On the examples of some of the arguments for creating stakeholder programmes, it was shown that the experience and views of the young entrepreneurs (participants in the reasearch conducted) are useful in defining the programmes and encouraging the young (in Serbia) towards entrepreneurship, by which the general hypothesis H(0) was confirmed in practise.

Naturally, the research resulted in many more and a much wider number of insights (applicable in practise), outside the purview of this paper, of which – for the sake of illustration – only a choice was presented (the authors hope: enough to be understood and perhaps even adopted). (The remaining data and ideas - will have to wait for another opportunity).

Decades of experience warn that this paper could, despite all its usability (and possibly even significance and modern day relevance), end up as merely „letters on a page". Those of us who – in Serbia – dwell in academia and research, still yearn for an environment where every kernel of knowledge will be greeted with enthusiasm (if only because it has been discovered marginally earlier than one's competition) and an eagerness to be put into practise, to enable even a small increase in competativeness, of life, of progress. It is beatiful, and also sad at times, to be a scientist – if there is no-one to understand and apply that science.

REFERENCES

Barringer, B. R., & Ireland, R. D. (2010). *Entrepreneurship: Successfully launching new ventures*. 3th edition, Pearson Education, Upper Saddle River, New Jersey, ISBN: 978-0-13-8155808-8.

Delgado, M. (2004). Social youth entrepreneurship: The potential for youth and community transformation. Greenwood Publishing Group.

Farashah, A. D. (2013). The process of impact of entrepreneurship education and training on entrepreneurship perception and intention: Study of educational system of Iran. *Education+ Training*, 55(8/9), 868-885.

Hutchinson, J., Guttentag, M., Chen, Y., Mo, K. (2012). *Youth Entrepreneurship in Serbia: Constraints and Opportunities*, The George Washington University.

Hsieh, C., Nickerson, J. A., & Zenger, T. R. (2007). Opportunity discovery, problem solving and a theory of the entrepreneurial firm. *Journal of Management Studies*, 44(7), 1255-1277.

Kasim, R. S. R., Zulkharnain, A., Hashim, Z., Ibrahim, W. N. W., & Yusof, S. E. (2014). Regenerating Youth Development through Entrepreneurship. *Procedia-Social and Behavioral Sciences*, 129, 322-327.

Labour Force Survey. (2014). Statistical Office of the Republic of Serbia. Link: http://webrzs.stat.gov.rs/WebSite/repository/documents/00/01/71/71/SB-593-bilten_ARS_2014.pdf (Accessed: April 15, 2016)

Moore, C.V., Petty, J.W., Palich, L.E., & Longenecker, J.G. (2008). Managing Small Business: An Entrepreneurial Emphasis, International Edition, 14th Edition, Cengage Learning.

Nabi, G., Holden, R., & Walmsley, A. (2010). Entrepreneurial intentions among students: towards a re-focused research agenda. *Journal of Small Business and Enterprise Development*, 17(4), 537-551.
Omerbegovic-Bijelovic, J. (1998). Metamanagement and quality of management (in Serbian: Metaupravljanje i kvalitet upravljanja), Andrejevic Foundation, Belgrade (Serbia).
Omerbegović-Bijelović, J. (2010). Basics of Operations management. University of Belgrade - Faculty of Organizational Sciences.
Papulová, Z., & Papula, J. (2015). Entrepreneurship in the Eyes of the Young Generation. Procedia Economics and Finance, 34, 514-520.
Roberts, K. (2008). The Young Self-Employed in East-Central Europe, p. 81, Chapter in Book: Blokker, P., & Dallago, B. (Eds.). (2008).
Robles, L., & Zárraga-Rodríguez, M. (2015). Key Competencies for Entrepreneurship. Procedia Economics and Finance, 23, 828-832.
Sobel, R. S., & King, K. A. (2008). Does school choice increase the rate of youth entrepreneurship?. *Economics of Education Review*, 27(4), 429-438.
Solesvik, M., Westhead, P., Matlay, H., & Parsyak, V. N. (2013). Entrepreneurial assets and mind-sets: benefit from university entrepreneurship education investment. *Education + Training*, 55(8/9), 748-762.
Vilcov, N., & Dimitrescu, M. (2015). Management of Entrepreneurship Education: A Challenge for a Performant Educational System in Romania. Procedia-Social and Behavioral Sciences, 203, 173-179.
World Bank Indicator (2013). Unemployement rate, unemployment youth total. Link: http://data.worldbank.org/indicator (Accessed April 15, 2016)
Zampetakis, L. A., Kafetsios, K., & Moustakis, V. (2013). The role of students' anticipated emotions in entrepreneurial intentions, IX Symposium of business and academics – SPIN 2013, 5-6 November, Belgrade, Serbia, 179-188.
Zhang, Y., Duijsters, G., & Cloodt, M. (2013). The role of entrepreneurship education as a predictor of university students' entrepreneurial intention. *International Entrepreneurship and Management Journal*. DOI: 10.1007/s11365-012-0246-z.

COMPANY'S GROWTH AS A RESULT OF ENTREPRENEUR'S CREATIVE ABILITIES

Žiga Peljko[1], Mitja Jeraj[2], Miha Marič*[3]
[1]KD Group d.d.
[2]GEA College, Faculty of Entrepreneurship Ljubljana
[3]University of Maribor, Faculty of Organizational Sciences
*Corresponding author, e-mail:miha.maric@fov.uni-mb.si

Abstract: *Key research objectives of the study were to empirically test how the independent constructs representing entrepreneur's creative abilities are connected to the construct of company's growth and to develop and empirically test a structural model linking these constructs. A two-country survey was made on a sample of entrepreneurs from Slovenia and USA. Findings showed that the entrepreneur's creative abilities are positively related to company's growth. Results of this study can be used both for further research and in practice.*

Keywords*: creativity, company growth, HRM, SEM, entrepreneurship.*

1. INTRODUCTION

Entrepreneurs are creative at work because they are expected or required to be (Unsworth, Wall and Carter, 2005; Antonio, Lanawati,Wiriana,&Christina, 2014).Bai, Lin and Ping Li (2016) define deliberate creativity as a proactive approach toward the production of novel and useful ideas that address a predicament or opportunity. Since creativity is a highly complex concept, one approach that has proven effective models creativity as a process (Chen, Chang and Lo, 2015). Entrepreneurs are role models for creativity and then continue to orchestrate opportunities (Albort-Morant, &Oghazi, 2016) for novel and unexpected behaviours (Jaussi and Dionne, 2003), which makes them successful (Tee Suan Chin, Raman, Ai Yeow, &Cyril Ezea, 2012). Entrepreneurs are a driving force (Ismail, 2014) by creating possibilities (Hjorth, & Holt, 2016), which gives them a leading role in economic development worldwide (De Vitaa, Mari, &Poggesi, 2014).

Our approach builds on the Basadur approach (2004) of creative problem solving and recognizes entrepreneur's creativity as a continuous, circular process, beginning with problem finding, followed by problem conceptualization, problem solving, and solution implementation, which is especially present when it comes to entrepreneurs (Baron, & Tang, 2011). The creative process is a creative cognitive processing of problems which consists of analysing and articulating the exact nature of the problem to be solved, preparing to solve the problem by gathering information and improving required skills, generating ideas for solving the problem, testing the chosen solution, and communicating the solution to others (Amabile and Mueller, 2008). Byrege and Tang (2015) even propose creativity training.

Creativity can be seen as generation of new ideas and innovation as commercialization of new ideas (Harris, 2009, Basadur, 2004), which fosters an entrepreneurial culture (Edwards-Schachter, García-Granero, Sánchez-Barrioluengo, Quesada-Pineda, & Amara, 2015) and therefore we can expect, that it leads to company's growth. For the purpose of this paper, we use the definition of creativity as a process (Basadur, 2004) that involves continuously finding and solving problems and implementing new solutions.

2. THEORETICAL REVIEW

2.1. Entrepreneur's creative abilities

Entrepreneurs are confronted with high uncertainty, which means more ill-defined and ambiguous problems that are characterized by multiple possible goals and multiple ways of solving the problem; also in the function of intermediation (Peng, Lee, & Hong, 2014). Creativity involves the generation of novel and useful ideas (Sarooghi, Libaers, & Burkemper, 2015) and entrepreneurial minds for continuous improvement (Kabukcu, 2015).The creative problem solver first constructs the problem to be solved, therefore, problem finding (Basadur, 2004) or problem construction or problem definition is the first step in the creative process (Basadur, Runco and Vega, 2000; Lubart, 2001). The way the problem is constructed has an impact on solution generation (Adelman, Gualtieri and Stanford, 1995) and is related to the quality and originality of

solutions to real-life problems (Reiter-Palmon, Mumford and Threlfall, 1998). Cognitive processes associated with creativity are central to the generation of creative output (Reiter-Palmon and Illies, 2004). Problem finding activity is intended to enable people to think in innovative ways, since discovered problems are more likely to be solved creatively than presented problems, and problem discovery itself is an important part of creativity.

After problem-finding activities are finished, a diverse and large amount of information has to be gathered and integrated. Problem solving integrates the thinking and behaviour we engage in to obtain the desired outcome we seek (Treffinger, Selby and Isaksen, 2008). Two main processes are used in problem solving activity: (1) search and collection of existing concepts and (2) the creation of new concepts through the connection and modification of existing concepts (Reiter-Palmon and Illies, 2004).

The utility of convergent and divergent thinking styles (Ashton-James and Chartrand, 2009) varies with social demands. Convergent thinking facilitates collaboration and coordination (Bahar and Hansell, 2000) while divergent thinking facilitates improvisation and innovation (Nemeth and Goncalo, 2005). Butler and Scherer (1997) found that the largest number of solutions are generated when goals are presented sequentially, one at a time to the problem solver and the highest quality solutions are generated when two conflicting goals are presented simultaneously to the problem solver.

Processes involved at the last phases have gained less attention than processes involved early in the creative cycle (Mumford, 2001). Solution implementation activity involves mainly persuasion and social skills (Reiter-Pulmon and Illies, 2004) and is subject to criticism, which involves fear of failure and the unknown. Creative solution implementation is supported by domain-relevant skills (knowledge and expertise), creativity-relevant skills and task motivation (Amabile, 1997). Elements of the work environment affect individual creativity by influencing expertise, task motivation, and creative skills (Amabile, 1997). Some (Chen, Chang, &Lee, 2015) even use the term creative entrepreneurs.

2.2. Company's growth

Since Lee (2010) argued that recently the study of the patterns and determinants of company's growth has re-emerged as one of the key research topics on firm dynamics in industrial economics (Sleuwaegen, & Boiardi, 2014) and management strategy this paper focused on the relations between the entrepreneur's creative abilities and company's growth. There exists also a term growth companies for those companies that generate significate positive flows, which increase faster than the overall economy (Growth Company Definition | Investopedia, 2016) and other companies.

When analysing company's growth, a common starting point is to specify a company's growth model that considers the impact of the size and age of the firm (Cucculelli & Ermini, 2012). Current study extends this area of research with following variables: average annual growth in number of employees in last three years; average annual growth in sales in last three years; and growth in market share in last three years. Companies must achieve sustainable growth (Sidik, 2012).

3. RESEARCH METHODOLOGY

3.1. Hypothesis

Creativity is a significant determinant of growth in modern economies (Sokol, Gozdek, Figurska, & Blaskova, 2015); based on this and on written above, we formulated three hypotheses to determine relations between the proposed constructs in the proposed model.

H1: Problem finding activity is positively related to company's growth.
H2: Problem solving activity is positively related to company's growth.
H3: Solution implementation activity is positively related to company's growth.

At the beginning of the next chapter, we present the data gathering process and the sample properties and thereafter continue with the results of current study, which we later on discuss and interpret.

3.2. Research setting and participants

For the purpose of this research the surveys were made available to entrepreneurs (i.e. founders or owners who participated in the start-up process of their company) from Slovenia and the USA. For the Slovenian

sample, the survey was administered in the Slovenian language, for the USA sample the survey was administered in English. The primary form of the questionnaire was in English language and translated for the Slovenian sample.
Emails with a link to the survey and a specific token for each respondent were sent to 4,000 entrepreneurs in Slovenia and to 5,000 entrepreneurs in the USA. Email addresses and addresses were selected randomly from public registers in both countries. Before completing surveys, entrepreneurs were assured that all answers provided would be kept anonymous. The survey included measures of entrepreneur's creative abilities and company's growth. Of the 331 questionnaires that were returned online, all were fulfilled fully because entrepreneurs could not continue on the next site of online survey if not all questions have been answered. At the beginning of the survey entrepreneurs had to select their gender, age and the country they reside in. The sample consisted of 237 (71.6%) male and 93 (28.1%) female respondents (one person did not declare about gender, as it was possible not to provide an answer in that particular question). The average age of the respondents was 46.51 years. 158(47.73%) of the respondents came from Slovenia and173 (52.27%) from the USA. Entrepreneurs' level of education is presented in Table 1.

Table 1: Sample structure by level of education

	Frequency	Percent
High school	4	1,2
High school graduate	9	2,7
College	33	10,0
Associate`s degree	71	21,5
Bachelor`s degree	60	18,1
Master`s degree	59	17,8
Doctoral degree	33	10,0
Professional degree	48	14,5
Other	14	4,2
Total	331	100,0

In addition, entrepreneurs also had to indicate if they are the founder or co-founder (Table 2) of the firm to where the survey had been send, and if they own such a firm (Table 3).

Table 2: Is the respondent a founder or co-founder of the company where the survey was sent?

	Frequency	Percent
Yes	231	69,8
No	100	30,2
Total	331	100,0

Table 3: Is the respondent owner in the company where the survey was sent?

	Frequency	Percent
Yes	254	76,7
No	77	23,3
Total	331	100,0

Further on we present the sample structure in regard to the respondents' companies by sector (Table 4).

Table 4: Sample structure in regard to the respondents' companies by sector

	Frequency	Percent
Banking, investment, insurance	29	8,8
Manufacturing industrial goods	31	9,4
Retail or wholesale trade	36	10,9
Construction	38	11,5
Engineering, research and development	17	5,1
Transportation or public utilities	9	2,7
Consumer services	25	7,6
Mining, extraction, oil	7	2,1
Tourism	21	6,3
Manufacturing consumer goods	12	3,6
Management consulting & business services	41	12,4
Other	65	19,6
Total	331	100,0

4. RESULTS

Combined analysis was performed for Slovenia and USA, because Slovenia and USA are relatively developed countries, with relatively high GDP, relatively low unemployment rate, with developed infrastructure, free market, peaceful development over decades, and high added value per employee.

The statistics for the variables included was conducted for both, the Slovenian sample and the US sample together and is presented in Table 5. The variables were divided into four researched constructs: problem finding, problem solving, implementing new solutions and company's growth.

Table 5: Statistics for the variables included in research (Slovenia and USA)

	Variable name	Mean	Median	Mode	Std. Dev.
Problem finding activity					
I can say that I like to "jump" into a new problem, without any previous analysing.	Q6a	3,31	3,00	4	,987
I am very fond of in circumstances where it is always full of changes.	Q6b	3,52	4,00	4	,871
Problem solving activity					
The best solutions come when I am working with others or when we talk about solutions.	Q6c	3,68	4,00	4	,941
I solve more tasks, if I work in a team.	Q6d	3,61	4,00	4	,989
Solution implementation activity					
My proposals for the solution of work problems are routinely translated into action.	Q6g	3,62	4,00	4	,809
I like to carry out experiments in practice - in the real world, i.e. the "business world".	Q6h	3,74	4,00	4	,831
In my work, I devote a lot of my time to improving work practices.	Q6i	3,66	4,00	4	,870

Company's Growth					
Average annual growth in number of employees in last three years	Q14	2,50	2,00	2	1,400
Average annual growth in sales in last three years	Q15	2,53	2,00	1	1,436
Growth in market share in last three years	Q16	2,75	3,00	2	1,147

In continuation, we present a method to test the model by applying structural equation modelling. That operation was made by building a model in Lisrel Student Edition 9.20, which is an analytical statistics program. For Slovenia and USA, the standardized solutions of the model are presented in Figure 1 and the T-test values in Figure 2.

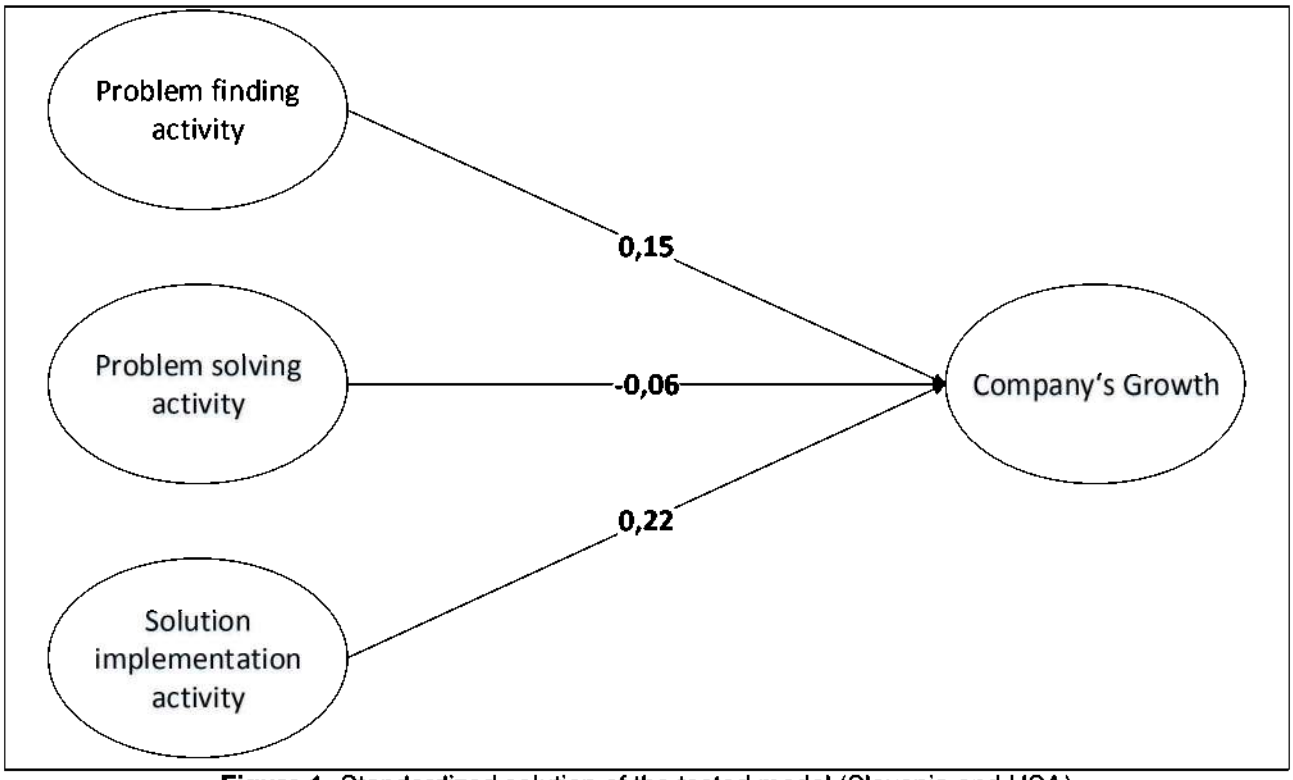


Figure 1: Standardized solution of the tested model (Slovenia and USA)

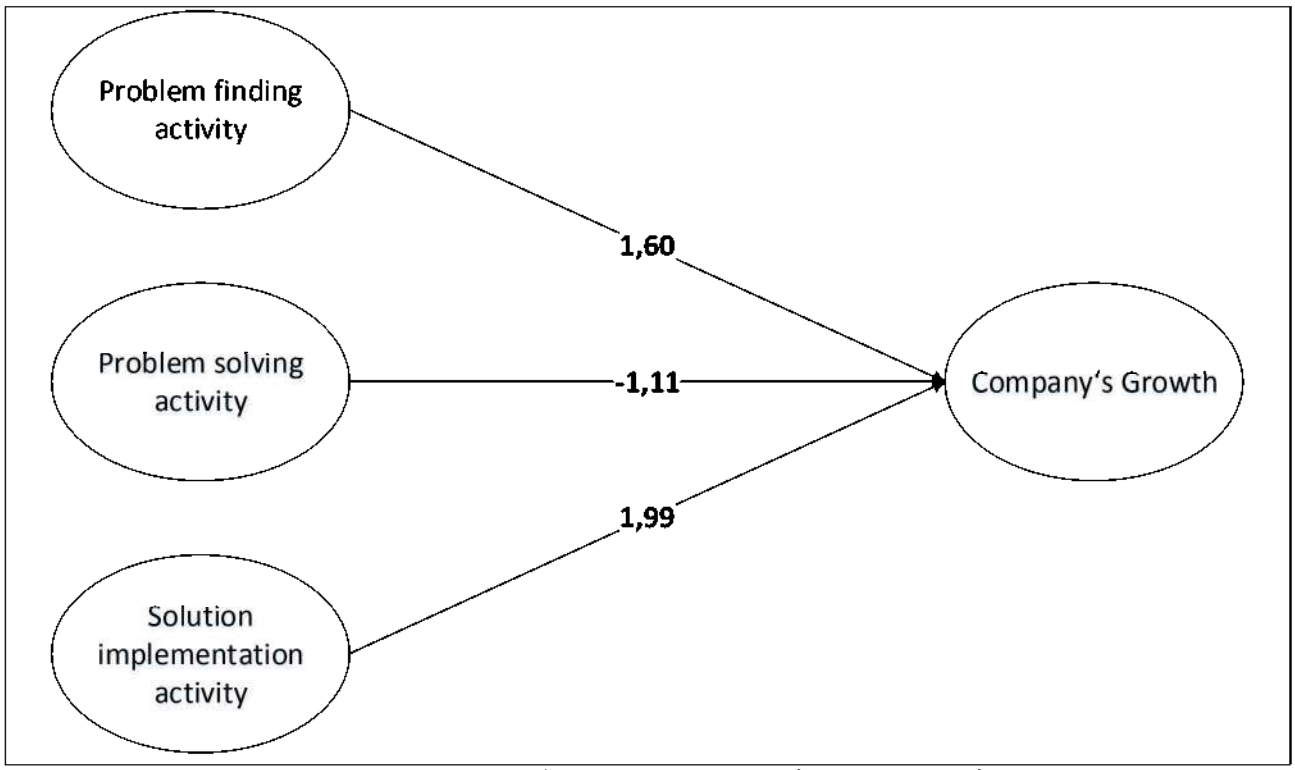


Figure 2: T-values for the tested model (Slovenia and USA)

5. DISCUSSION

Our research intended to test the structural relations between entrepreneur's creative abilities and company's growth from the viewpoint of entrepreneurs. Our main aim was to test three hypotheses. Therefore, we launched the diagrams and presented the course of the research model, which tested these relations (Figure 1). The standardized coefficient values are presented in Figure 1, and the t-test values in Figure 2. We used a combination of exploratory and confirmatory methods with the goal to develop a model, which complemented theoretical predisposition and fit the data.

The fit indices of the structural model (Figure 1) present a good model fit for developed countries (Slovenia and USA), which is indicated by the values of $\chi 2/df = 2.602$ and RMSEA=0.070, NFI = 0.900, CFI = 0.935, SRMR = 0.0689, GFI = 0.957. With defined hypotheses we wanted to test the relations between the constructs in this model; one of three shows a statistical significance according to the t-test values whereas the whole model shows statistical significance of P-value=0.00001.

As seen from Figure 1 in developed countries (Slovenia and USA) higher level of entrepreneur's creative abilities is positively related to company's growth, whereas we cannot confirm that with statistical significance regarding the relations between the problem finding activity and company's growth (H1) and problem solving activity and company's growth (H2) and we can confirm with statistical significance the positive relation between the solution implementation activity and company's growth (H3); the influence is low to moderate (0.22), positive and statistically significant (**t=1.99**).

6. CONCLUSION

Entrepreneurs that are more creative (Bredvold, &Skålén, 2016) are also more capable of evaluating solutions and identifying the most creative solutions (Basadur, Runco and Vega, 2000). Company's growth is what all companies strive for. Entrepreneur's creative abilities are therefore important determinants of company growth; as shown, entrepreneur's creative abilities lead to company's growth (Groza, Locander, & Howlett, 2016), which is why we must enrich entrepreneur's creative processes (Sigala, & Chalkiti, 2015). Creativity is simply a requirement in today's competitive market (Sönmez, 2013). According to this research, entrepreneur's creative abilities are definitely a promising research field and it needs to be taken into consideration. The question that comes to mind instantly is on how entrepreneurs can implement these results in practice. Combining the different but intertwined constructs gives us better insights and enables

practitioners to further improve their efficiency, effectiveness and their chances for success in the real world and tough world of entrepreneurial ventures.

There is an increasing tendency for government policy to promote entrepreneurship for its apparent economic benefit (O'Connor, 2013; Marič, Jeraj and Pavlin, 2009); development of entrepreneurship can present possible model for decreasing unemployment rate (Čudanov, Jaško and Săvoiu, 2012). Based on that knowledge, the same effort should be invest to the scientific research related to this field. Entrepreneurship should be presented not only as an alternative but also mainly as the first choice of professional engagement in order to make it more accessible and rewarding.

Several limitations of this study need to be considered before interpretations of the results can be explored. First; the discussed findings and implications were obtained from a single study; generalizing the results should be done with caution. The fact that the research was conducted in USA and Slovenia where economy is based mostly on private ownership and freedom of entrepreneurial initiative. In these two countries, the main restraint for entrepreneurial activity is financial capital beside the entrepreneurial inspiration. Second; the whole research was focused mostly on how entrepreneurs creative abilities influence company's growth, whereas other determinants were not considered.As mentioned entrepreneur's creative abilities are not the only determinants of company's growth, therefore we can only propose that entrepreneur's creative abilities in part affect company's growth whereas there are also other factors involved in the process of success. It also does not mean that creative entrepreneurs succeed with their ideas (Gicheva, & Link, 2015).

For further research, we suggest investigating the effects of the determinants omitted or to put in other words not included in our study. These determinants could be divided into those influencing company's growth besides entrepreneur's creative abilities such as situational and other attributive determinants.

REFERENCES

Adelman, L., Gualtieri, I.,& Stanford, S. (1995). Examining the effect of casual focus on the option generation process: An experiment using protocol analysis. *Organizational Behavior and Human Decision processes*, 61(1), 54-66. doi:10.1006/obhd.1995.1005

Albort-Morant, G., &Oghazi, P. (2016). How useful are incubators for new entrepreneurs?*Journal of Business Research,* 69(6), 2125–2129. doi:10.1016/j.jbusres.2015.12.019

Amabile, T.M. (1997). Motivating creativity in organizations: On doing what you love and loving what you do. *California Management Review*, 40, 39-58.

Amabile, T.M., &Mueller, J.S. (2008). Studying Creativity, Its Processes, and Its Antecedents: An Exploration of the Componential Theory of Creativity, in: Zhou, J., Shalley, C. E. (eds): *Handbook of organizational creativity*, Lawrence Erlbaum Associates, New York, 33-64.

Antonio, T., Lanawati, S., Wiriana, T. A., &Christina, L. (2014). Correlations Creativity, Intelligence, Personality, and Entrepreneurship Achievement. *Procedia - Social and Behavioral Sciences,* 115, 251–257. doi:10.1016/j.sbspro.2014.02.433

Ashton-James, C.E., &Chartrand, T.L. (2009). Social cues for creativity: The impact of behavioral mimicry on convergent and divergent thinking. *Journal of Experimental Social Psychology*, 45, 1036-1040.doi:10.1016/j.jesp.2009.04.030

Bahar, M.,& Hansell, M.H. (2000). The relationship between some psychological factors and their effect on the performance of grid questions and word association tests. *Educational Psychology*, 20 (3), 349-364. doi:10.1080/713663739

Bai, Y., Lin, L., & Ping Li, P. (2016). How to enable employee creativity in a team context: A cross-level mediating process of transformational leadership. *Journal of Business Research,* In Press. doi:10.1016/j.jbusres.2016.02.025

Baron, R. A., & Tang, J. (2011). The role of entrepreneurs in firm-level innovation: Joint effects of positive affect, creativity, and environmental dynamism. *Journal of Business Venturing,* 26(1), 49–60. doi:10.1016/j.jbusvent.2009.06.002

Basadur, M. (2004). Leading others to think innovatively together: Creative leadership. *The Leadership Quarterly*, Elsevier, 15, 103-121. doi:10.1016/j.leaqua.2003.12.007

Basadur, M., Runco, M.A., &Vega, L.A. (2000). Understanding how creative thinking skills, attitudes and behaviors work together: A casual process model. *Journal of Creative Behavior*, 34 (2), 77-100. doi:10.1002/j.2162-6057.2000.tb01203.x

Bredvold, R., &Skålén, P. (2016). Lifestyle entrepreneurs and their identity construction: A study of the tourism industry. *Tourism Management,* 56, 96–105. doi:10.1016/j.tourman.2016.03.023

Brygle, C., & Tang, C. (2015). Embodied creativity training: Effects on creative self-efficacy and creative production. *Thinking Skills and Creativity,* 16, 51–61. doi:10.1016/j.tsc.2015.01.002

Butler, A.B., &Scherer, L.L. (1997). The effects of elicitation aids, knowledge, and problem content on option quantity and quality. *Organizational Behavior and Human Decision Processes*, 72, 184-202.

Chen, M.-H., Chang, Y.-Y., &Lee, C.-Y. (2015). Creative entrepreneurs' guanxi networks and success: Information and resource. *Journal of Business Research,* 68(4), 900–905. doi:10.1016/j.jbusres.2014.11.049

Chen, M.-H., Chang, Y.-Y., & Lo, Y.-H. (2015). Creativity cognitive style, conflict, and career success for creative entrepreneurs. *Journal of Business Research,* 68(4), 906–910. doi:10.1016/j.jbusres.2014.11.050

Čudanov, M., Jaško O. & Săvoiu G. (2012). Public and Public Utility Enterprises Restructuring: Statistical and Quantitative Aid for Ensuring Human Resource Sustainability. *Amfiteatru Economic Journal*, 32, 307-322. Retrieved from http://www.amfiteatrueconomic.ro/temp/Article_1126.pdf

De Vitaa, L., Mari, M., &Poggesi, S. (2014). Women entrepreneurs in and from developing countries: Evidences from the literature. *European Management Journal*, 32(3), 451–460. doi:10.1016/j.emj.2013.07.009

Edwards-Schachter, M., García-Granero, A., Sánchez-Barrioluengo, M., Quesada-Pineda, H, &Amara, N. (2015). Disentangling competences: Interrelationships on creativity, innovation and entrepreneurship. *Thinking Skills and Creativity,* 16, 27–39. doi:10.1016/j.tsc.2014.11.006

Gicheva, D., & Link, A. L. (2015). On the economic performance of nascent entrepreneurs. *European Economic Review,* In Press. doi:10.1016/j.euroecorev.2015.07.018

Growth Company Definition | Investopedia. (2016). Retriewed from http://www.investopedia.com/terms/g/growthcompany.asp

Groza, M. D., Locander, D. A., & Howlett, C. H. (2016). Linking thinking styles to sales performance: The importance of creativity and subjective knowledge. *Journal of Business Research,* In Press. doi:10.1016/j.jbusres.2016.03.006

Harris, A. (2009). Creative leadership: Developing future leaders. *Management in Education*, 23(1), 9-11.doi: 10.1177/0892020608099076

Hjorth, D., & Holt, R. (2016). It's entrepreneurship, not enterprise: Ai Weiwei as entrepreneur. *Journal of Business Venturing Insights*, 5, 50–54. doi:10.1016/j.jbvi.2016.03.001

Ismail, V. Y. (2014). The Comparison of Entrepreneurial Competency in Woman Micro-, Small-, and Medium-scale Entrepreneurs. *Procedia - Social and Behavioral Sciences,* 115, 175–187. doi:10.1016/j.sbspro.2014.02.426

Jaussi, K.S., &Dionne, S. D. (2003). Leading for creativity: The role of unconventional leader behavior. *The Leadership Quarterly*, 14 (4-5), 475-498. doi:10.1016/S1048-9843(03)00048-1

Kabukcu, E. (2015). Creativity Process in Innovation Oriented Entrepreneurship: The case of Vakko. *Procedia - Social and Behavioral Sciences,* 195, 1321–1329. doi:10.1016/j.sbspro.2015.06.307

Lee, C.-Y. (2010). A theory of company's growth: Learning capability, knowledge threshold, and patterns of growth. *Research Policy*, 39(2), 278-289. doi: 10.1016/j.respol.2009.12.008

Lubart, T.I. (2001). Models of the creative process: Past, present and future. *Creativity Research Journal*, 13(3-4), 295-308. doi:10.1207/S15326934CRJ1334_07

Marič, M., Jeraj, M., & Pavlin, J. (2009). Entrepreneurship as a solution to the unemployment problem. Paper presented at the *Poslovno okruženje u Srbiji i svetska ekonomska kriza*.

Mumford, M.D. (2001). Something old, something new: Revisiting Guilford's conception of creative problem solving. *Creativity Research Journal*, 13(3), 267-276. doi: 10.1207/S15326934CRJ1334_04

Nemeth, C.J., &Goncalo, J. A. (2005). Creative collaborations from afar: The benefits of independent authors. *Creativity Research Journal*, 17(1), 1-8. doi: 10.1207/s15326934crj1701_1

O'Connor, A. (2013). A conceptual framework for entrepreneurship education policy: Meeting government and economic purposes. *Journal of Business Venturing*, 28(4), 546-563. doi: 10.1016/j.jbusvent.2012.07.003

Peng, M. W., Lee, S.-H., & Hong, S. J. (2014). Entrepreneurs as intermediaries. *Journal of World Business,* 49(1), 21–31. doi:10.1016/j.jwb.2013.04.003

Reiter-Palmon, R., &Illies, J.J. (2004). Leadership and creativity: Understanding leadership from a creative problem solving perspective. *The Leadership Quarterly*, 15(1), 55-77. doi:10.1016/j.leaqua.2003.12.005

Reiter-Palmon, R., Mumford, M.D., &Threlfall, K.V. (1998): Solving everyday problems creatively: The role of problem construction and personality type. *Creativity Research Journal*, 11(3), 187-197. doi: 10.1207/s15326934crj1103_1

Sarooghi, H., Libaers, D., & Burkemper, A. (2015). Examining the relationship between creativity and innovation: A meta-analysis of organizational, cultural, and environmental factors. *Journal of Business Venturing,* 30(5), 714–731. doi:10.1016/j.jbusvent.2014.12.003

Sidik, I. G. (2012).Conceptual Framework of Factors Affecting SME Development: Mediating Factors on the Relationship of Entrepreneur Traits and SME Performance. *Procedia Economics and Finance,* 4, 373–383. doi:10.1016/S2212-5671(12)00351-6

Sigala, M., & Chalkiti, K. (2015). Knowledge management, social media and employee creativity. *International Journal of Hospitality Management,* 45, 44–58. doi:10.1016/j.ijhm.2014.11.003

Sleuwaegen, L., & Boiardi, P. (2014). Creativity and regional innovation: Evidence from EU regions. *Research Policy,* 43(9), 1508–1522. doi:10.1016/j.respol.2014.03.014

Sokol, A., Gozdek, A., Figurska, I., & Blaskova, M. (2015). Organizational Climate of Higher Education Institutions and its Implications for the Development of Creativity. *Procedia - Social and Behavioral Sciences,* 182, 279–288. doi:10.1016/j.sbspro.2015.04.767

Sönmez, M. (2013). Creativity and Solid Modeling. *Procedia - Social and Behavioral Sciences,* 93, 169–173. doi:10.1016/j.sbspro.2013.09.172

Tee Suan Chin, S., Raman, K., Ai Yeow, J., &Cyril Ezea, U. (2012). Relationship Between Emotional Intelligence And Spiritual Intelligence In Nurturing Creativity And Innovation Among Successful Entrepreneurs: A Conceptual Framework. *Procedia - Social and Behavioral Sciences,* 57(9), 261–267. doi:10.1016/j.sbspro.2012.09.1184

Treffinger, D.J., Selby, E.C., &Isaksen, S.G. (2008). Understanding individual problem-solving style: A key to learning and applying creative problem solving. *Learning and individual Differences*, 18 (4), 390-401.doi:10.1016/j.lindif.2007.11.007

Unsworth, K.L., Wall, T.D., &Carter, A. (2005). Creative Requirement: A Neglected Construct in the Study of Employee Creativity? *Group&Organization Management*, 30(5), 541-560. doi: 10.1177/1059601104267607

FEMALE ENTREPRENEURSHIP: MAIN CHALLENGES AND THE IMPACT OF GENDER GAP

Dunja Kokotović*[1], Bogdan Rakić [1], Tijana Kokotović [2]
[1]University of Belgrade, Faculty of Organizational Sciences
[2]University of Belgrade, Faculty of Economics
*Corresponding author, e-mail: dunjakokotovicc@gmail.com

Abstract:*This paper presents a studyof entrepreneurship with the focus on female entrepreneurship, its main challenges and the impact of gender inequality. So called gender gap in entrepreneurship is present in almost every country and there are no signs that the situation is going to change. In order to achieve equality for women compared to men and to prove the potential of these women, it is necessary to join forces much broader than one country. The aim of this paper is to show that in spiteof many barriers which women are facing, there is a great unlocked potential of self-employed women. Examples from Serbia and abroad were analyzed as part of monitoring progress in this areas.*

Keywords*: entrepreneurship, female entrepreneurship, gender gap, self-employment, empowering women*

1. INTRODUCTION

Female entrepreneur may be defined as a woman or group of women who initiate, organize, and run a business enterprise. Women enter entrepreneurship due to economic factors which pushed them to be on their own and urge them to do something independently.We see a lot of women professionals in engineering, medicine, law etc. They are also setting up hospitals, training centers, etc. Women entrepreneurs are risk bearers, organizers and innovators too. (Sharma, 2013)

Female entrepreneurship needs to be studied separately for two main reasons. The first reason is that female entrepreneurship has been recognized during the last decade as an important untapped source of economic growth. Women entrepreneurs create new jobs for themselves and others and by being different also provide society with different solutions to management, organisation and business problems as well as to the exploitation of entrepreneurial opportunities. However, they still represent a minority of all entrepreneurs. Thus there exists a market failure discriminating against women"s possibility to become entrepreneurs and their possibility to become successful entrepreneurs. This market failure needs to be addressed by policy makers so that the economic potential of this group can be fully utilized.(OECD, 2004)

The purpose of this paper is to prove that female entrepreneurs are really recognized as big part of economy and economic growth, but in spite of that there is still big gender gap when it comes to entrepreneurship and the only way to make that gap smaller is to encourage female entrepreneurship all over the globe and keep the percent of self-employed women raising. Also, research on distribution of self-employed women across industrieswill be presented in this paper.

2. ENTREPRENEURSHIP

The business literature differentiates entrepreneurs from business people by including statements such as: entrepreneurs “create needs”; while business people “satisfy needs”.(Kelley, Bosma, & Amorὸs, 2011) Entrepreneurs are conceptualized as individuals who see the world differently and envision the future better than others do. They seize opportunities that otherwise would go unnoticed. They perceive and accept risks differently than others. (Abu-Saifan, 2012)Entrepreneurship is the process of designing, launching and running a new business, i.e. a startup company offering a product, process or service.(Yetisen et al., 2015)The entrepreneurial organization is opportunity-focused, without neglecting important problems, it must give priority to the new and innovative.(Drucker, 2015)

List of personal characteristics that make some people better at recognizing business opportunities than others are by (Barringer & Ireland, 2012): 1) Prior experience in an industry (which helps entrepreneurs to recognize business opportunities); 2) Cognitive factors (opportunity recognition may be an innate skill or a cognitive process); 3) Social networks (the extent and depth of an individual"s social network affects opportunity recognition); 4) Creativity (encourages the process of generating novel or useful ideas). No

matter what type of business they're in, no matter their gender, and no matter their age, entrepreneurs of all kinds face challenges in starting and growing companies. Not surprisingly, the types of challenges they face tend to be similar.

3. TYPES OF ENTREPRENEURS

Not all entrepreneurs are the same. The term entrepreneur is used to describe any person launching and managing his or her own business, but in reality there are many different types of entrepreneurs. There are four broad categories of entrepreneurs as (Fisher, 2011) points out: survivalists, lifestyle entrepreneurs, growth entrepreneurs and revolutionaries.

1) Survivalists are in business merely as a means of economic survival. They operate micro enterprises to feed themselves and their families. They create very little long-term wealth in their operation; they are merely keeping the business afloat while living on the profits from one day to the next. Examples of survivalist entrepreneurs can be found all across South Africa – they are the basket sellers on Durban beachfront, the people selling sunglasses on the corner of William Nicol Highway and Republic Road and the person selling Stormers flags outside Newlands Rugby ground.

2) Lifestyle entrepreneurs get into business as a means to a particular lifestyle. Being in business for themselves means that they can live in a certain place, have the freedom to pursue another passion (such as music, sailing, writing) and the autonomy to dictate when they do and don't work. They tend to engage in higher value activities and use more infrastructure compared to survivalists. They therefore usually need to make a larger upfront investment in the business than survivalists but they get better returns. In most cases these people are forgoing the certainty of being an employee in an existing business for the freedom of autonomy and choice that goes with being an entrepreneur. The owner of a thriving guesthouse in Plett, the coffee shop owner who needs time for his music and the local nail parlour owner who wants afternoons off to spend with her kids are all examples of lifestyle entrepreneurs.

3) Growth entrepreneurs are driven by the competitive nature of business. They get into business for themselves to create something of long-term value and they continually seek to make the business bigger and more competitive. They usually need to make a larger investment in the business than lifestyle entrepreneurs, both in terms of upfront capital investment and the time they invest in managing the business as it grows. They often take on more risk than lifestyle entrepreneurs but that risk comes with financial rewards if the business succeeds. The consultant who keeps hiring more associates to service more clients, the media entrepreneur who is continuously launching new products to sell more advertising space and the estate agent who is franchising her operation to facilitate growth are all examples of growth entrepreneurs.

4) Revolutionaries create a business as a means to change the world. They are driven to disrupt and reshape markets. They look to make big bets and if these pay off they usually become famous. Globally, Steve Jobs, Richard Branson and Bill Gates have left indelible marks on the industries they entered. In South Africa, Raymond Ackerman reshaped the retail industry, Adrian Gore disrupted the healthcare sector and Gidon Novick turned domestic airline travel on its head. Such entrepreneurs often need to invest substantial amounts of capital in their businesses to facilitate growth; with that comes high expectation. They are notorious for working hard and for demanding much of those who work for them.

These four kinds of entrepreneurs can be represented in a simple diagram which depicts the investment required and the revenue generated by the different categories of entrepreneurs.

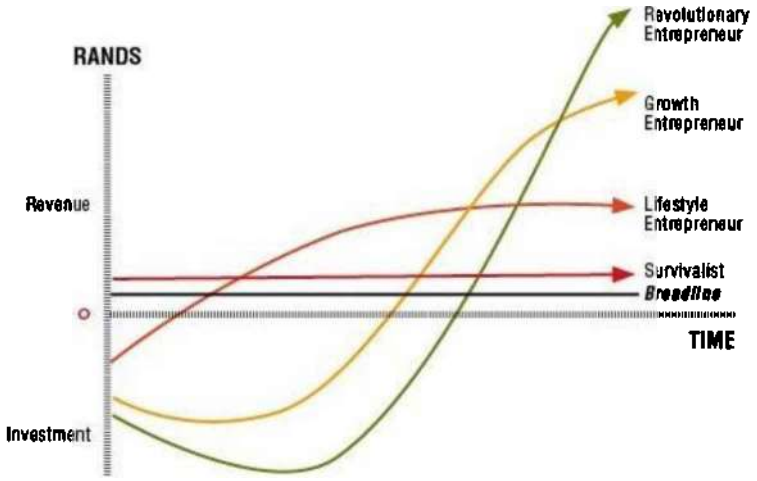


Figure 1: Types of Entrepreneurs (Fisher, 2011)

4. POTENTIAL FOR FEMALE ENTREPRENEURS

Economic development cannot be achieved without active participation of women in all aspects of life. There is consensus among scholars that women can play key role in the entrepreneurial phenomenon.(Revenga & Shetty, 2012) Women entrepreneurs have been designated as the new engines for growth and the rising stars of the economies in developing countries to bring prosperity and welfare. A variety of stakeholders haspointed at them as an important „untapped source" of economic growth and development.(Maria Minniti & Naudé, 2010)The share of women's contribution to the economic and social development depends on the promotion of gender equality and gender blind support from the institutions. Although women constitute about fifty percent of the world population, compared to men, they have less opportunity to control their lives and make decisions. (Revenga & Shetty, 2012)

Women entrepreneurs are self-employed mostly in the services sector which it can be seen in OECD research. About 80% of self-employed women work in the services sector compared to less than 60% for men. In Germany, Israel and the United Kingdom, the share of self-employed women working in the services sector is above 90%.

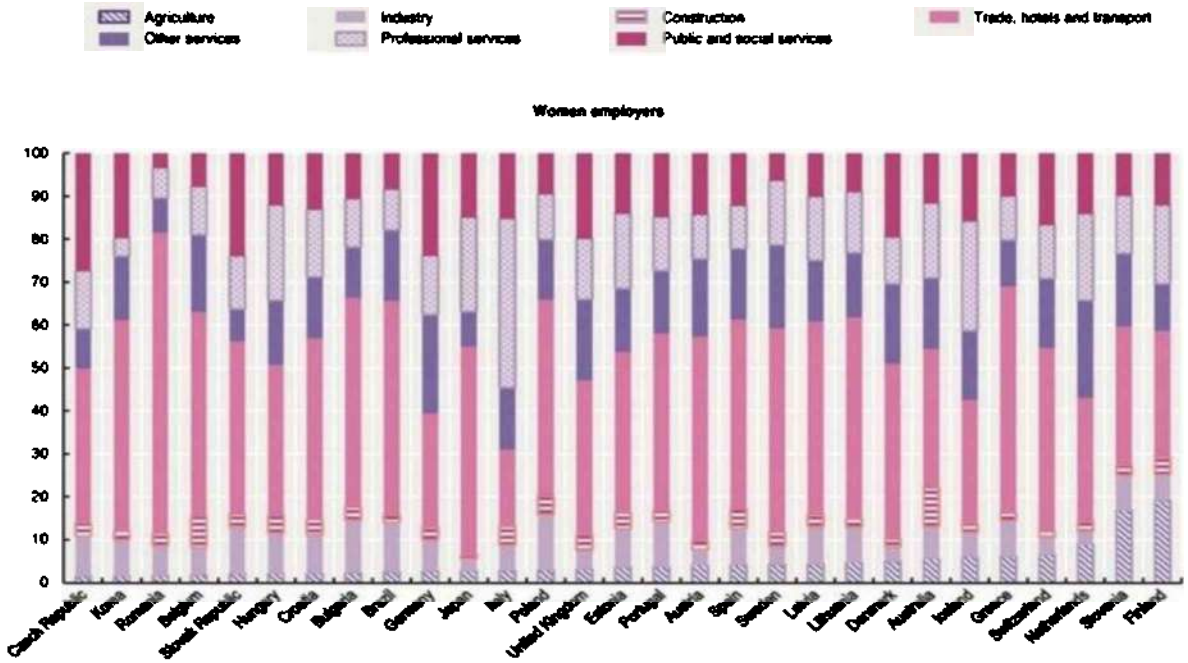


Figure 2: Distribution of self-employed women by sector – Women employers (percentage)(OECD, 2015)

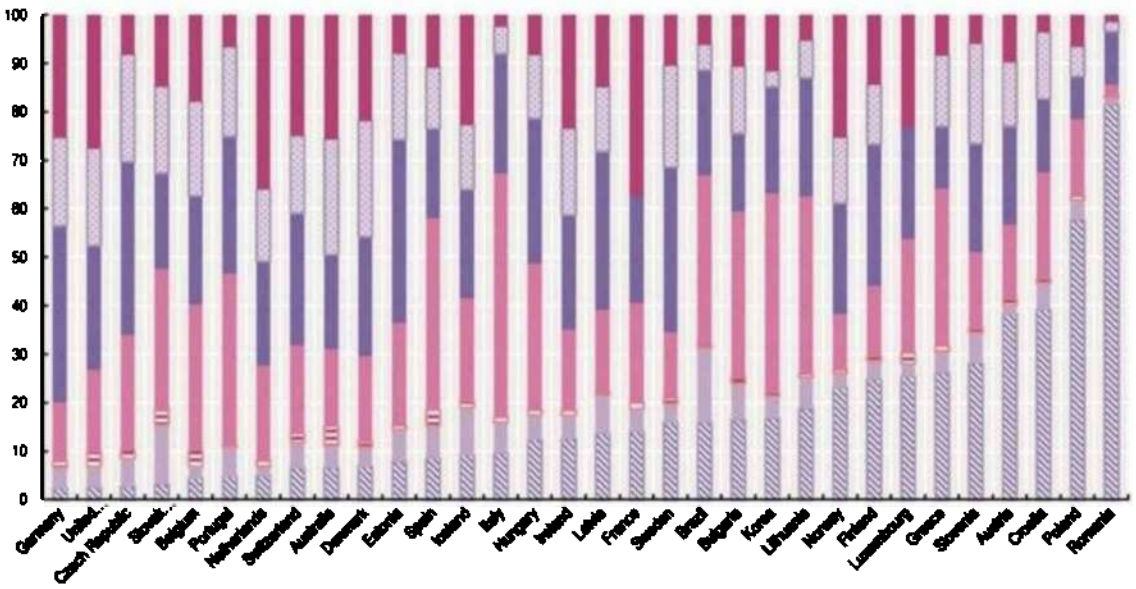


Figure 3: Distribution of self-employed women by sector – Women own account workers (percentage)(OECD, 2015)

Based on population census data agriculture includes agriculture, forestry and fishing; industry includes manufacturing, mining and quarrying, and other industries; trade, hotels and transportation include wholesale and retail trade, transportation and storage, accommodation and food service activities; other services include information and communication, financial and insurance activities, real estate activities and other services; professional services include professional, scientific, technical, administrative and support service activities; public and social services include public administration, defence, education, human health and social work activities. Not all the self-employed are "entrepreneurs". Self-employment statistics include for example, craft-workers and farmers. Care is thus needed in interpreting the data in analyses of entrepreneurship (OECD, 2015). This shows that women find the greatest potential to work in Trade, hotels and transportation sector.

5. DRAWBACKS AND INCENTIVES FOR FEMALE ENTREPRENEURSHIP

Entrepreneurship can be a very rewarding, and yet difficult, path to take. The inherent uncertainty of starting and running a business can be especially daunting for poor women in developing countries.Nonetheless, many do try – a testament that speaks to the intensity of their drive, the allure of economicempowerment, and the strength of their commitment to improving life for themselves and their families, butoften also speaks to the scarcity of employment and other opportunities for many women.For example, property rights in some countries are very weak or poorlyprotected – and worse still for women. Lack of secure knowledge that one can keep what one owns and earnsis a major disincentive to entrepreneurial activity. A nontransparent investment climate or discrimination can discourage women from striking out on their own and make it harder for them to start and maintainbusinesses.Credit, above all, can be hard for women to obtain, and terms can be so unfavorable as to make loanscounterproductive. Some women may be unable to access credit because they may lack a credit history orthe official documentation needed to do business with a formal financial institution, or have no collateral dueto legal or cultural barriers that prevent them from having assets titled in their names.

Most women entrepreneurs need some form of support in developing their businesses. Access to capital isusually the most important need, but mentoring from other businesspeople can convey valuable skills andlessons to the entrepreneurs and can be a valuable source of employee engagement and renewal for the privatesector.There are a number of important ways in which the private sector can support and sustain female entrepreneurs(McKinsey&Co, 2010):

- Extend credit to female entrepreneurs, on terms that recognize the unique challenges and circumstancesfaced by women in developing countries and emerging markets
- Advocate for credit standards, property rights protections, and asset documentation rules thatdo not disadvantage women
- Provide mentoring to women entrepreneurs
- Encourage or create equal opportunities for women entrepreneurs
- Encourage supply chain diversity (e.g., actively seek women-owned enterprises as supply chainparticipants, support women's inclusion in supply chain opportunities).

6. GAP BETWEEN GENDERS

6.1. The phenomenon of inequality between the sexes

The concept of gender describes the socially created roles, norms, behavior, expectations and activities attributed to women and men. Gender equality has been highlighted as one of the eight Millennium Development Goals, and as a key to achieving the other seven goals by(UNFPA, 2013). There is consensus that women can play key role in the entrepreneurial phenomenon. Gender inequality exists in terms of economic development as well as the rates of entrepreneurial activity. There is a significant gender gap in the entrepreneurial activity rate across the world. (Allen, Elam, Langowitz, & Dean, 2008) A GEM (Global Entrepreneurship Monitor) study of 18 economies from 2002 to 2010 suggests that women's entrepreneurial activity is lower than that of their male counterparts at different stages of development.(Kelley et al., 2011) Treating women as the second gender means ignoring and underestimating huge potential human resources. Women entrepreneurs can play crucial roles in the process of economic development if they have equal opportunity and access to resources. In spite of the growing number of female entrepreneurs, the share of female entrepreneurship is still significantly low compared to their participation rate (Minniti & Arenius, 2003). Especially in Less Developed Countries with high female unemployment rate, for some women who need to work at home, entrepreneurship can be a practical solution to earn income and reduce their unemployment rate and poverty (Sarfaraz, Faghih, & Majd, 2014).
GEM Women's Report, 2011 shows that over time, the gender gap between entrepreneurs increased in some countries and decreased in others. Overall, as the economies move to a higher level of development, the rate of entrepreneurial activity decreases, regardless of gender. So, in more developed economies that both men and women have different options for employment, individuals seems to be more interested in having secured jobs rather than starting their own businesses. However, in general, the entrepreneurial gap between women and men decreases with economic development level (Kelley et al. 2011).

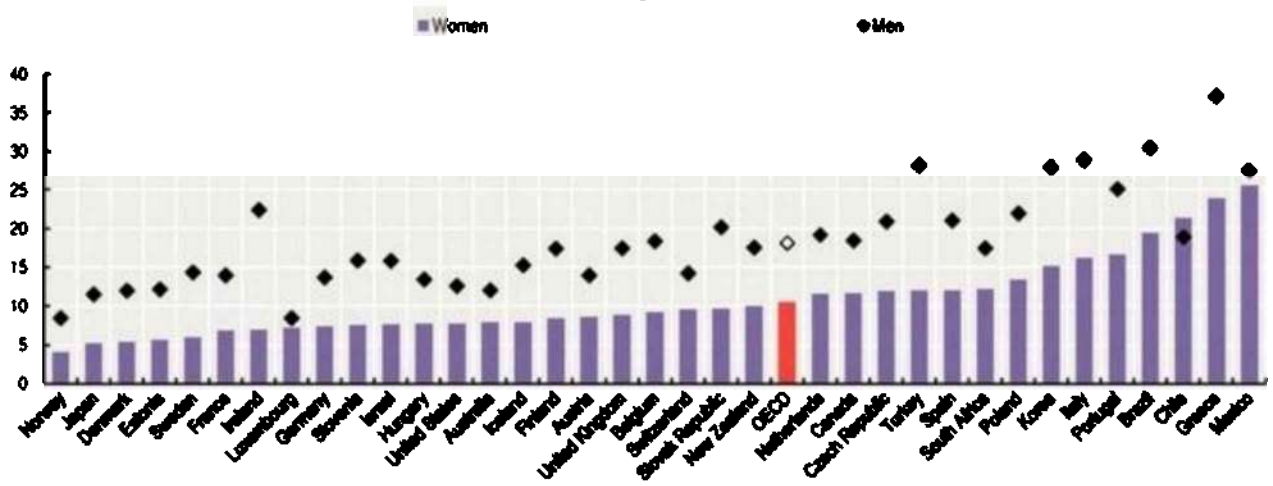


Figure 4: Share of self-employed men and women (OECD, 2015)

6.2 Gap in taking risk

There are inherent risks when choosing to set-up a new business. However, some of these risks, like attaining a satisfactory work-life balance are often more inhibiting for women than for men. In fact, independently of a country's economic context and the overall cultural attitude toward entrepreneurship, women always appear less prone to take the risk of creating their own business than men. The share of men who would rather take a risk and build their own business than work for someone else is larger in virtually all countries, from high income OECD countries to least developed low income economies.

The sentiment of not having the adequate education and finances to be able to create one's own business is one important factor explaining this gender gap. Typically, lower shares of women than men declare having access to training or funding to create or grow a business. Policy initiatives that encourage women's participation in formal and informal training, enlarge or adapt the offer of training courses, and enable their access to suitable funding, including through financial education, should constitute key elements in the promotion of female entrepreneurship(OECD, 2015).

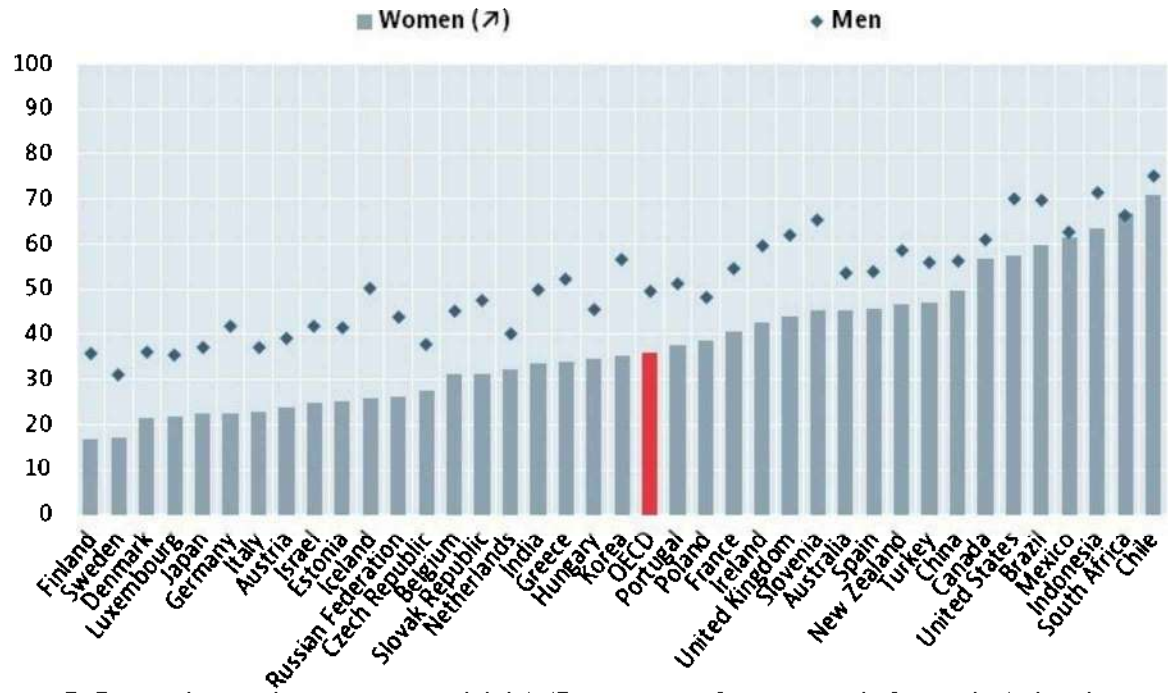


Figure 5: Perception on the entrepreneurial risk (Percentage of women and of men declaring they would rather take a risk and build their own business than work for someone else, 2013) (OECD, 2015)

6.3. Gap in earnings from self-employment

Women remain substantially underrepresented as entrepreneurs. Men are two to three times more likely to own businesses with employees than women. The most striking difference between men and women in entrepreneurship is the scale of their business operations. Self-employed women earn much less than men. In all countries, the gender gap in earnings from self-employment is greater than the wage gap; typically, women work on average fewer hours in their businesses.(OECD, 2015)

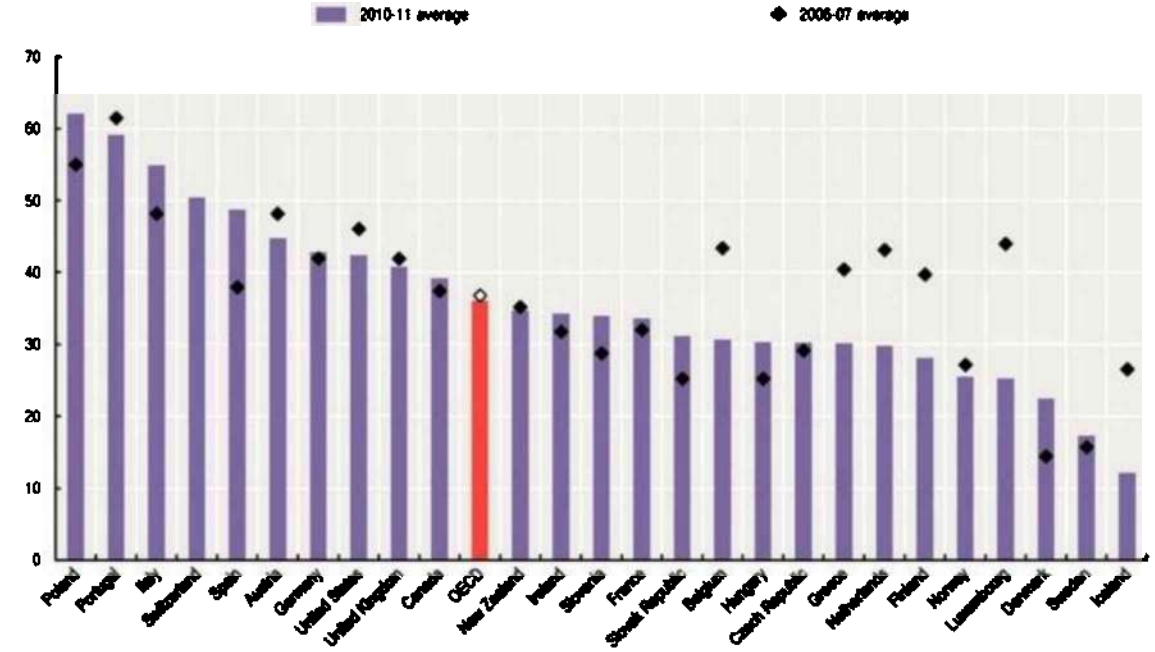


Figure 6: Gender gap in self-employment earnings in percentage points (OECD, 2015)

7. ENTREPRENUERSHIP IN SERBIA

Serbian government announced year 2016 to be theYear of Entrepreneurship. This decision was made on the fact that sector of SMSC is the most vital part of the economy, but this development opportunity has not been used enough. There are 320 000 small and medium-sized companies (SMSC) in Serbia. Majority of

them stated that they need governmental help. Growth in the sector of small and medium-sized companies and founding of new micro-companies are imperative for employment, and management of the transitional changes in economy based on the knowledge is key challenge to the entrepreneurship. The trend of entrepreneurial mindset, living and doing business is a challenge for creation of truly entrepreneurial society in which the key development carriers are creative businessmen, enduring innovators, young entrepreneurs and managers. However entrepreneurs don"t feel the state"s support. The biggest problem that managers faced so far are non-liquidity in the economy, no discipline in the financial transactions, monopolized market, disloyal competition, grey economy, chronic lack of financial incentives for investment and business sustainability, lack of market and demand, as well as lack of qualified work force. Observing the entrepreneurial structure Serbia could create developing technological paradigm of innovative profile in almost all economy sectors. Having in mind high level of SMSC sector"s influence on the economy growth in the EU, in Serbia we lack trends that are present in the EU due to long-term wandering in strategies and inadequate implementation of Act on small business, which negatively presented in the years since the beginning of the financial crisis.

Table 1: Structure of small and medium-sized enterprises in Serbia(Chamber of Commerce and Industry of Serbia, 2016)

Entrepreneurship in Serbia			
99,8% is participation of the entrepreneurial sector in Serbian economy (320 000 SMSC)		**33%** is GDP contribution	
64% of the population is employed	**42%** participates in export		**4,5%** SMSC is export-oriented
Number of Employees			
40% are micro and small forms with 1 employee	**36%** has 2 - 5 employees	**21%** employs 6 – 20 people	**4%** has over 20 employees
Ownership Structure			
70% of companies has 1 owner	**27%** has 2 owners		**5,7%** has 3 or more owners
The Management			
73% of owners directly manages the company	**28%** has managerial role	**4%** do not manage the company although they are employed	**1%** of owners do not work in the company they founded
Educational Profile of the Businessmen			
65% has high-school	**18%** has elementary school		**22%** has high and higher education

According to the report of the World Economy Forum for 2015/16, Serbian businessmen stated access to the funds as 2nd business hurdle, just behind inefficient state bureaucracy, and in front of corruption, taxation rates and regulations. Serbia is by ease of getting credit ranked low: 120th of 140 participating countries. Majority of small and medium-sized companies does not use credits from the formal sources, and when they use them those are small amounts, usually cash loans and overdrafts. Banks" offers are inacceptable for them: high interest rates, expensive and complicated procedures, requirements for collateral, lack of long-term credits…

Sectors in which there is great potential for development in Serbia are IT, agriculture – organic food and creative industry. In Serbia there are a lot of good examples of successful small companies. One of them is Zoran Ilic, CEO of the Biomelem company, who says for himself that he is entrepreneur from the moment when he got self-employed few decades ago. He thinks that state should appreciate and promote entrepreneurship much more so young people would desire to also become entrepreneurs.(Chamber of Commerce and Industry of Serbia, 2016)

As it is stated in the National Youth Strategy 2015– 2025 for Serbia (National Youth Strategy 2015– 2025, Ministry of Youth and Sports, Republic of Serbia) youth entrepreneurship is not properly developed, while the contribution of entrepreneurship to the reduction of youth unemployment has not been sufficiently recognised.There must be some conditions provided for the development of entrepreneurship in Serbia, especially for the young people. Some of the expected results and planned activities are:

- Developed supportive public policy framework that defines youth entrepreneurship and its environment
- There are mechanisms in place for the acquisition of entrepreneurial knowledge and skills and financial literacy within the framework of education
- Developed sustainable programmes for supporting young people who opt for self-employment
- Created conditions for the development of social entrepreneurship among youth, based on social understanding and support to entrepreneurship and innovation.

8. RESEARCH OFFEMALE ENTREPRENEURSHIP IN SERBIA

As (Babović, 2012)points out, GEM research is one of the few initiatives that allows monitoring of entrepreneurship on an international level according to standardized indicators and methodology. Unfortunately, the data which provide a systematic international comparison with insights into gender differences are only available for 2007. According to these data, in Serbia, in 2007, among women aged 18-64 years was 7.9% entrepreneurs, while among men of the same age was 19.9% of entrepreneurs. In addition, 5% of women of that age were being established job or in the early stage of business (as opposed to 12% of men), while 2.8% of women of that age were at the head of a business based (as opposed to 7.7% men).Based on this, we can see that situation with female entrepreneurship in Serbia is similar as in other countries – gender gap is present, and also not many of women in Serbia are motivated and strong enough to start their own businesses and that's why they need support from specific institutions.

There are many associations in Serbia which encourage femaleentrepreneurship in Serbia, and one of them is "Association of Business Women in Serbia". They've had several projects for promoting and helping women in Serbia so far such as: "Inclusion in employment", "See my story and become a Woman Entrepreneur", "The development of women's entrepreneurship", "Service development for women's start-up promotion" etc (Association of Business Women in Serbia. 2015). Association of Business Women in Serbia awards every year the „Success Flower" Award to the best female entrepreneurs in Serbia.The „Success Flower" Awards are being given in two categories: "most European women's company" and "the best model for employing women," as well as in a sub-category "self-employment/start-up". In addition to basic, they are award special honors to successful entrepreneurs for contribution to the development of female entrepreneurship in the various business segments where they have achieved significant success in both domestic and foreign markets such as: Special award for corporate social responsibility, Special award for supporting enterprises in business, Special award for innovation, Special recognition for the development of entrepreneurship in rural areas and Special award for sustainable business model. This association is led by successful ambassadors of female entrepreneurship in Serbia:

- Anja Ivana Milić, architect, founder and owner of projecting and building company "Arhi pro";
- Afrodita Bajić, who is engaged in the production of sales of women's fashion garments' AMC-"Afrodite mode collection"
- Dragica Božinović, founder and owner of the trade company "Novitas"
- Zorica Selaković, founder of firm of home-made cakes and cookies "DESSERT"
- Jasmina Knežević, Director of General hospital "Bel Medic"
- Ljiljana Stanojević, director of the company, she is engaged in metal processing, production and trade of machine elements, "Stanojevic"
- Marija Stevanović, the owner of the Agency for consulting and management "MS Employment"
- Marina Milić, director and owner of the company, engaged in the production, processing and sale of honey products "Maja promet"
- Nataša Milanović, owner of the company, engaged in the production and processing of organic food "Biosil"
- Sanja Knežević, the owner and manager of a tourist and cultural center "Ethnoselo Latkovac"

Those are all very successful women who try every day to support and encourage other unemployed women to take step forward and to gain strength to start their own businesses.

Also, there is Association of business women "Nadežda Petrović" from Čačak, whose main project is "Let's learn production occupationsin order to become employed and independent". During this project, the

association gives opportunity to young and inexperiencedfemale entrepreneurs to attend many useful trainings about business and self-employment, to meet with experienced entrepreneurs in order to learn about their experiences, to promote their business idea etc.

9. CONCLUSION

Women are wise, worthy, working, courageous, strong, persistent, persevering, successful mothers and wives. One thing is certain that it is difficult to be a woman entrepreneur, but a lot of the challenges and the limits will certainly change. The theme of equality between men and women is very popular nowadays and everything points to the fact that this gap will be smaller in the future, but in order to make that real, women can't make that on their own, they need support. Support from government institutions or different associations for encouraging female entrepreneurship can cause the increase in the percentage of women who are self-employed for a reason that many of them are not aware of the possibilities, and even those who are aware often do not have the financial resources to enter into such an adventure. Situation in Serbia is similar to other countries when it comes to both men and female entrepreneurship, and the fact that this year, 2016 is pronounced as The year of entrepreneurship in Serbia shows that the awareness and the number of entrepreneurs is getting a bit bigger, but crucial changes in percentages of self-employed women are not going to happen if they don't get more opportunities regarding financial resources and moral support.The greatest help for women can be new mechanisms for financial support in starting new businesses across the globe and also to give them proper formal education of entrepreneurial skills and knowledge and financial literacy skills so they can become more independent while starting their businesses.

REFERENCES

Abu-Saifan, S. (2012). Social entrepreneurship: definition and boundaries. *Technology Innovation Management Review*, (February), 22–27. Retrieved from http://www.timreview.ca/article/523

Allen, E., Elam, a B., Langowitz, N., & Dean, M. (2008). Global Entrepreneurship Monitor 2007: report on women and entrepreneurship. *Babson Park, MA: Babson College*.

Association of Business Women in Serbia, (2015) (http://www.poslovnezene.org.rs/en/category/projects/current), date of access:27.03.2016

Babović, M. (2012). Polazna studija o preduzetništvu žena u Srbiji. Published by United Nations Development Programme in Serbia.
(http://www.secons.net/admin/app/webroot/files/publications/1PolaznastudijaopreduzetnistvuzenauSrbiji.pdf)

Barringer, B. R., & Ireland, R. D. (2012). *Entrepreneurship: Successfully Launching New Ventures*. *Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki*. Retrieved from http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:No+Title#0

Chamber of Commerce and Industry of Serbia (2016) *National Business Review,* January 2016

Drucker, P. F. (2015). *Innovation and entrepreneurship: Practice and principles*. London: Routledge.

Fisher, Greg (2011). *Which Type of Entrepreneur are You?* (http://www.entrepreneurmag.co.za/advice/growing-a-business/performance-and-growth/which-type-of-entrepreneur-are-you/), date of access: 03.04.2016.

Kelley, D. J., Bosma, N., & Amorós, J. E. (2011). Global Entrepreneurship Monitor. 2010 Global Report. *Global Entrepreneurship Research Association GERA*, 1–85.

McKinsey&Co. (2010). The Business of Empowering Women. http://doi.org/10.1177/026455058903600405

Minniti, M., & Arenius, P. (2003). Women in entrepreneurship. …□ *: First Annual Global Entrepreneurship …*, 1–28. http://doi.org/10.1007/s11365-007-0051-2

Minniti, M., & Naudé, W. (2010). Introduction: What Do We Know About The Patterns and Determinants of Female Entrepreneurship Across Countries? *European Journal of Development Research*, *22*(3), 277–293. http://doi.org/10.1057/ejdr.2010.17

National Youth Strategy 2015-2025, Ministry of Youth and Sports, Republic of Serbia

OECD. (2004). Promoting Entrepreneurship and Innovative SMEs in a Global Economy: Towards a More Responsible and Inclusive Globalisation, (June), 74.

OECD. (2015), *Entrepreneurship at a Glance 2015*, OECD Publishing, Paris.

Revenga, A., & Shetty, S. (2012). Empowering women is smart economics. *Finance and Development*, *49*(1), 40–43.

Sarfaraz, L., Faghih, N., & Majd, A. (2014). The relationship between women entrepreneurship and gender equality. *Journal of Global Entrepreneurship Research*, *2*(1), 6. http://doi.org/10.1186/2251-7316-2-6

Sharma, Y. (2013). Women Entrepreneur In India. *IOSR Journal of Business and Management*, *15*(3), 09–14. http://doi.org/10.9790/487X-1530914

United Nations Population Fund UNFPA, (2013). *Gender Equality: A Cornerstone of Development*

Yetisen, A. K., Volpatti, L. R., Coskun, A. F., Cho, S., Kamrani, E., Butt, H., … Yun, S. H. (2015). Entrepreneurship. *Lab Chip*, *15*(18), 3638–3660. http://doi.org/10.1039/C5LC00577A

ORGANIZATIONAL SPECIFICS OF SMALL AND MEDIUM ENTERPRISES WITH A SPECIAL OVERVIEW OF MARKETING FUNCTION

Valentina Vukmirović*[1], Nikola Vukmirović[2]
[1]University of Belgrade, Faculty of Organizational Sciences
[2]University of Banja Luka, Faculty of Economics
*Corresponding author, e-mail: valentina.vukmirovic91@gmail.com

Abstract: *Due to its specific performances, small and medium enterprises have very significant role in contemporary economic development. Specifics of their organizational structure have led to development of new marketing approach which is, compared to traditional marketing approach, more suitable for small and medium enterprises. Relationship marketing, which results in marketing network created by entrepreneur and enterprise management, is most commonly associated with marketing of small and medium enterprises. Results of the research conducted in this paper indicate that relationship marketing and marketing network concept, in comparison with classic marketing mix concept, is more adequate for implementation in small and medium enterprises.*

Keywords: *organizational structure, entrepreneurial venture, small and medium enterprises management, entrepreneurs, marketing feature*

1. INTRODUCTION

Avlijaš (2008) states that in overall structure of business entities in developed countries, small and medium enterprises share is usually up to 99%. Likewise, their share in GDP structure exceeds 60% and in overall structure of the employed exceeds up to 80% (p. 1). These statistical data indicates that small and medium enterprises are very important feature in national economy development. Accordingly, Krivokapić and Jaško (2014) claim that modern economy is actually based on entrepreneurial ventures, due to the fact that entrepreneurship provides solutions for many economic problems, and improves national economies (p. 1332).

Scarborough (2014) discusses thatbusiness efficiency, as well as small and medium enterprises growth, greatly depends upon efficiency of their organizational structure and organization of key business activities (p. 127).Gibson et al. (1997)state thatenterprise dimensionality has a great significance in process of designing its organizational structure (p. 194).The aim of this paper is to put emphasis on significance of organizational efficiency of small and medium enterprises, which influences their growth, development and contribution to overall economy development. According to Ferrell and Hirt (1996) performances which determine role and significance of small and medium enterprises are connected with production assets, human resources, business scope, business orientation etc. (p. 86)Deakins and Freel (2012) state thatdue to these factors, small and medium enterprises are commonly orientated towards external organizations in performing significant activities such as marketing, import, export, market research etc. (p. 63)Hatten (2014) claims that, according to management guru Peter Drucker, business has two, and only two, basic functions: marketing and innovation (p. 79). Thereby, special attention will paid to specific organization of marketing function of small and medium enterprises, which enables them to improve collaboration with all stakeholders, especially with consumers whom contemporary marketing theory defines as value creators.

This paper presented organizational specifics of small and medium enterprises, which significantly influence their growth, development and work efficiency. Furthermore, particular attention will be paid to organizational specifics of marketing feature, and its significance for small and medium enterprises development.According to Gutić and Rudelj (2009) this topic is very interesting to observe due to the fact that organization of marketing, in most domestic enterprises, is visibly falling behind development of corporate organization, in all of its aspects (p. 262).In accordance with this unfavorable trend, authors of this paper conducted a research among 54 small and medium enterprises in Republic of Serbia, in order to obtain information about marketing organization development in domestic enterprises. Information was gathered by using questionnaire method. Results of this research indicate that, even though a large number of small and medium enterprises in domestic market conduct certain form of marketing activities, a small percentage of enterprises that were involved in this research conduct marketing activities regularly and consistently in accordance with specific marketing plan.

Hatten (2014) states that each entrepreneurial venture presents the result of the entrepreneurial intentions of individuals or groups(p. 43).Rakićević et al. (2014) claim that success of an enterprise is, to a large degree, defined bythe individual's entrepreneurial intentions andmanagerial competences, as well as willingness to "sacrifice" themselves for achieving business objectives (p. 551).Due to specific organizational structure of small and medium enterprises, main hypothesis in this paper is related to the role of entrepreneur in marketing decision making. Authors' assumption is that domestic entrepreneurs do not develop marketing feature of their enterprise to a significant extent due to their perception that all the important decisions in the enterprise should be made by them. Furthermore, most entrepreneurs in domestic market observe marketing function as non-decisive factor for achieving business success. Results of the research reaffirm these hypotheses to a large degree.

2. KEY FEATURES OF SMALL AND MEDIUM ENTERPRISES AND THEIR PHASE DEVELOPMENT CHARACTERISTICS

Milošević et al. (2014) state that small and medium enterprises development ensures the largest contribution to the increase in employment, gross added value and turnover, and is, therefore, considered to be the backbone of growth and development of a national economy (p. 520). Even though there is not a unique approach towards defining concept of small and medium enterprises, yet Siropolis (1995) states that largest number of countries uses these following criteria for defining small and medium enterprises:

- Total assets (total financial means, supplies, land, real estate, machines etc.),
- Number of employees,
- Invested capital or gross income,
- Equities (p. 8).

In accordance with valid legislation in Republic of Serbia (Accounting Act "Official Gazette of Republic of Serbia"No. 62/2013, p. 5) enterprises are classified into micro, small, medium and large according to average number of employees, total income and asset value on the day of financial report composition in the latest financial year. In order to be categorized as micro, small or medium enterprise, legal entity must fulfill at least two of three following criteria:

For micro enterprises

- Average number of employees is 10,
- Average business income is 700.000 € in Dinar counter value,
- Average value of business asset (calculated as an arithmetic average value at the beginning and the end of the financial year) is 350.000 € in Dinar counter value.

For small enterprises

- Average number of employees is 50,
- Average business income is 8.800.000 € in Dinar counter value,
- Average value of business asset (calculated as an arithmetic average value at the beginning and the end of the financial year) is 4.400.000 € in Dinar counter value.

For medium enterprises

- Average number of employees is 250,
- Average business income is 35.000.000 € in Dinar counter value,
- Average value of business asset (calculated as an arithmetic average value at the beginning and the end of the financial year) is 17.500.000 € in Dinar counter value.

Avlijaš (2008) discusses that small and medium enterprises represent factor of stability in the market, due to the fact that they fullfil blank niche space which cannot be filled by large enterprises, especially in period of great demand when they are capable of creating rapid supply increase, unlike large enterprises which

maintain stable demand value (p. 8).Deakins and Freel (2012) discuss that, in an opposite situation when demand is decreased, small and medium enterprises can easily adapt their business operation volume, unlike large enterprises which do not adjust its business to market demands due to larger fixed costs per product (p. 45).Milošević et al. (2014) state that main characteristics of small and medium enterprises are the reason for much easier adaption to continuous changes in consumer demand and business conditions in the global market. Those characteristics primarily refer to their size, flexibility, propensity for innovative and risky ventures, as well as greater opportunity for specialization (p. 552). Therefore, Kuratko (2014) claims that small and medium enterprises cause strengthening of competition, which leads to improvement of product quality, lower prices, innovations and development of new technologies, and the growth of overall national economy (p. 63). Their significance is especially noticeable in countries in transition, such as Serbia, which are usually struggling with high rates of unempolyment, as well as low level of foreign investments and reduced economic activity. Therefore, it can be stated that small and medium enterprises represent an important factor for social and economic stability of a country. Hatten (2014) verifies this statement by stating that numerous surveys indicate that small and medium businesses have created 64% of net new jobs over the past 20 years, employ half of all private sector employees and create more than 50% of GDP (p. 47).

Scarborough (2014) discusses that small and medium enterprises management has its specifics which are caused by nature and characteristics of small business development. In initial development phase, entrepreneurial ventures are usually confronted with lack of funds which significantly influences their organizational structure creation (p. 134).Reijonen(2010) states that small and medium enterprises are characterized by small number of employees who simultaneously perform more than one business activity, including the owner himself (p. 283). Enterprise development and its capacity increase lead to changes in its organizational structure. Vučenović et al. (2009) discuss that, in the initial development phase, enterprise is defined as entrepreneurial organization, in which one person, entrepreneur, dominates the organization in order to achieve personal purposes (p. 231).Initial development phase is crucial for product development and its market placement. In this phase of venture's development, knowledge, skills and experience of the entrepreneur are of decisive importance. Furthermore, Hatten (2014) state that, as a key factor in the organization, entrepreneur is responsible for most of managerial activities, as well as decisions which are related to production, purchase, sales, financial means providing and organizational structure creation(p. 117).

Cvijanović (2004) states that initial organizational problems occur when the enterprise broadens its activities. Meanwhile, enterprise expands its capacities, but business activities management models remain the same (p. 99).Vučenović et al. (2009) claim that, due to its growth, enterprise faces issues which exceed one person's capability to efficiently manage business activities (p. 232). However, theentrepreneur rejects a possibility to leave responsibility for entrepreneurial risk to associates. Meanwhile, there are still not enough financial possibilities for engaging professional managers or consultants. Radić et al. (2015) state that, due to these reasons, initial development phase of management is mostly based on knowledge and experience of the entrepreneur and less on applying scientific methods of enterprise management and business organization (p. 333). Entrepreneur individually makes decisions on all matters which can result in negligence of strategic issues of enterprise development and growth.

Vukmirović (2006) discusses that, due to the fact that enterprise development and growth is becoming accelerated and is not coordinated with development of managerial knowledge and skills, business activities stagnation may occur as a consequence (p. 194).Radić et al. (2015) suggest thatthis problem could be solved by engaging a team of managers who would reassess theowner's decisions, and objectively make decisions, due to the fact that they do not participate in the ownership structure(p. 334). More precisely, enterprise is forced to develop functional organizational structure, because of the fact that every business activity demands active managing.Jaško et al. (2013) state that functional organizational model is suitable for small and medium enterprises, since their focus is usually oriented towards specific product or market. This structure is suitable for enterprises which create its competitive advantage with distinctive competence in one or few business functions, such as production for example(p. 555). The following development phase leads to overcoming one product and onemarket orientation, which requires implementation of organizational structure modification. Functional organizational structure should be adjusted to markets or products, i.e. conduct division of organizational structure. Krivokapić and Jaško (2014) state that, in accordance with market changes, i.e. dynamism and instability of the environment, it should be remembered that once established mode of behavior might be changed, since the organization must continuously follow possible changes in the environment (p. 1338). Higher level of adjustment to changes in the environment provides enterprise with better business results.

3. SMALL AND MEDIUM ENTERPRISES ORGANIZATIONAL FUNCTIONS

Enterprise organizational structure represents one of main management functions which implies designing organization and its inner systems.According to Gibson (1997) organizational structure implies manner in which organization's activities are distributed, gathered and coordinated between managers and employees and represents an asset for management goals accomplishment (p. 104). Designing organization includes forms which mutually connect employees, as well as forms in which employees are connected with their assignments. Cvijanović (2004) states that, with the aim of designing optimal organization model for certain enterprise, it is necessary to observe its structure, processes and context (p. 17).Enterprise structure includes decentralization of authorities, formalization, and standardization of work operations as well as a number of hierarchy levels and geographical sites in which business operations are conducted. Processes refer to activities of decision making, coordination and communication inside the organization. Context implies circumstances and conditions in which organization is doing business, such as main aims of the organization, technology, human resources, environment etc. Jaško et al. (2013) discuss that efficient and effective organization provides rational resources usage as well as development, which integrates adequate methods and models which should fulfill expectations of different stakeholders (consumers, employees, owners, partners, competitors, society etc.)(p. 417). Organizational design of a certain entrepreneurial venture requires presence of adequate organizational knowledge and skills, as well as competent organizational project team. Designing organizational structure of small and medium enterprises which have entrepreneurial development and management orientation significantly differs from designing organizational structure of traditional firms. Audretsch and Thurik (2004) claim that this can primarily be noticed through significantly simpler and more flexible organizational structure which rapidly adapts to changes in business environment(p. 145).

Hills (1996) states that, since every enterprise's business purpose is to find adequate market for its products and therefore materialize business idea on which it is based, creating adequate organization of marketing activities represents key factor for achieving market success. (p. 62) Gerber (2010) claims that, by distributing its products on the market and finding customers, enterprise can acquire verification of the innitial idea on which it is based (p. 55).Reijonen (2010) discusses that the necessity for marketing sector existence within an organization emerges from the need for business plan creation, which includes market research, competitor analysis, development opportunities research etc. (p. 282). Likewise, Kotler (2001) states that marketing sector should provide creation of distribution channels, organization and improvement of sales system, creation of price policy, planning of promotional activities, as well as creating trade mark and brand development (p. 279). Organizational structure, enterprise capacity and circumastances in which business is being managed are factors which are defining a manner in which marketing sector is organised within an enterprise. Gutić and Rudelj (2009) claim that marketing organization is not a general scheme or pattern which can be applied in every entreprenurship byfollowing the same model due to the fact that every organization is specific and shaped by numerous internal and external factors which sould be monitored and explored(p. 262).

3.1. Organization specifics of marketing function in SME

Reijonen (2010) states that, since marketing theory has been developed on the basis oflarge organizations studies, it cannot be applied directly to small and medium enterprises, due to the fact thatthese marketing practices may significantly differ from those of their larger counterparts (p. 280). Therefore, the need to develop specific marketing theory, which would be suitable for small and medium enterprises, has been recognized.
According to Hills (1996), in countries with developed economies it is considered that marketing sector should include all commercial operations and that it should possess the same rank in organizational structure and hierarchy of an enterprise as other sectors such as production or finances (p. 112).Sparling et al. (1994) discuss that, marketing sector, organized in this manner, should perform functions such as purchase, sales, market research, distribution and promotion (p. 199). According to company's needs and its specific circumstances, the number of employees for every business activity is defined.

Within enterprise marketing feature, sales represent one of the most important operational activities. Depending on the type of industry in which enterprise operates, its production capacity, sales range and other enterprise specifics, different organizational models of this enterprise feature exist. According to Vasiljev et al. (2002) two categories of sales organization and management models can be distinguished:

- Sales management as marketing function model and
- Management of sales processes model(p. 168).

Management of sales process refers to higher hierarchy level in organization which implies owners, board of directors and top management, who are making strategic sales decisions. Vasiljev et al. (2002) state that this system is considered to be developed along with marketing development through following development phases:

- Phases of line models of sales management, direct-line and line and staff model,
- Phases of cooperative functional models,
- Team model phases, i.e. project-team, market-team and innovation-team models, which represent more thorough implementation of marketing in enterprise management (p. 185).

Direct-line model represents the earliest form of sales management and its essential task is to provide management control. According to Lovreta et al., (1998) line and staff model represents certain breakthrough in terms of sales management, due to the fact that it includes advisory role of expert, even though members of management structure are still entirely responsible for decision making(p. 232).Cooperative functional model implies that it is necessary to establish cooperative relations between all enterprise functions, as well as sub-functions i.e. marketing services such as informing, analysis, forecasting and alternative consideration, with the aim of sales decision making.Siropolis (1995) discusses that main characteristic of numerous and various functional models of marketing organization is the existence of unique and direct chain for marketing organization management which includes one superior and one or few subordinate employees (p. 298).Team sales management models require competences and collaboration of larger number of different profile experts who create teams for resolving certain problems during the process of sales decision making. Kalinić (1993) states that this type of organization is flexible, due to the fact that teams are formed by available experts in enterprise, as well as external associates who are periodically engaged (p. 205).

Organizational structure of purchase service is very similar to organizational structure of sales function. According to Lovreta et al. (1998), the role of this service is very important for regular supply of production sector, which provides prerequisite for sustained production which is coordinated with sales needs (p. 232).Kalinić et al., (2002) discuss that, in case of trading enterprises, purchase service is directly connected with sales sector, because of the fact that sales needs to be provided with quality merchandise in time and in an amount which market requires (p. 177). Therefore, it is necessary to provide tight correlation between these two services. Organizational structure of purchase service may be created regarding areas of supply, supplied merchandise as well as combination of these two models.
Other marketing activities consider market research, promotional activities, informational marketing systems, marketing activities planning etc. Siropolis (1995) states that these activities may be organized in form of services, created for fulfilling marketing management sector needs (p. 310). For performing these work tasks, employees from these sectors collaborate with production and other operative sectors and are directly responsible to marketing management sector.

Gutić, Rudelj (2009) state that, in accordance with small and medium enterprises specifics, project-matrix organization model is suitable for this type of business ventures(p. 264). It is based on, at least, dual command system. Every employee in marketing sector of an enterprise is liable to at least two managers. Jaško and Kostić (1997) discuss that project-matrix structure is usually applied in order to achieve specific strategic marketing aim, such as new product placement, or modification of existing product in its maturity phase (p. 108). This structure can also be applied in enterprises where changes in technology are major, frequent and intense, and is, as well, suitable for medium-sized enterprises whit several product lines. This model of marketing organization is commonly used in states of significant uncertainty in enterprise environment.According to Jaško et al. (2013), project-matrix organization model is suitable in cases of enterprise adjustment to current market demands, such as product differentiation, new product placement, product modification, increase of loyalty and satisfaction of consumers etc.(p. 567-574).

3.2. Small and medium enterprises key marketing specifics

Hatten(2014) states that marketing involves all the points of contact between small or medium enterprise and its customers (p. 147). Small and medium enterprises marketing is fundamentally different, and usually much more successfully conducted, than marketing practice in large enterprises. According to Hills(1995), reason for such phenomena may be that within small and medium enterprises marketing development is observed as decisive success factor in comparison with, for example, planning or strategy development (p. 219). Unlike large enterprises that include large number of experts in process of decision making, small and medium enterprises marketing practice usually delegate all important decisions towards one person.

Accordingly, some enterprises make marketing decisions on their own, while others make marketing decisions in collaboration with very influential individuals in this field, i.e. marketing experts.

In the article about marketing myopia, Theodore Levitt indicates that enterprises which did not have their focus on customers' needs, but on their own needs instead, experienced failure. Most business ventures operate today with a customer-driven philosophy, which indicates that customer wants and needs are determined before goods and services are produced. This philosophy is called the marketing concept. Business concept that broadens marketing concept view is called relationship marketing. This concept indicates that business owner should recognize the value and profit potential of customer retention. Kotler and Keller(2006) state that therefore, main aim of this concept is to develop long-term, mutually satisfying relationship with stakeholders, primarily with customers and suppliers (p. 281). Due to the fact that one of basic characteristic of small and medium enterprises imply that owner / manager / entrepreneur has strong influence in decision making process, it can be stated that relationship marketing concept is convenient for small and medium enterprises. His management competence strongly influences enterprise business success, especially in the initial development phase when business operations are highly personalized and defined by knowledge and capability of the entrepreneur. Due to the fact that in small and medium enterprises owner is most commonly creator of the initial idea and organizational structure of the enterprise, it can be concluded that development of marketing activities is also conducted under owner's strong influence. This statement can be confirmed by McGrath (2008) who notes that enterprise venture owners customize marketing activities to personal needs, and usually do not have marketing specialist or sector which is engaged with development and implementation of marketing activities (p.21). In addition, Butigan and Mahnić (2011) claim that classic marketing mix theory is not applicable in case of small and medium enterprises. These authors elaborate that the owner's prominent role in enterprise structure is the key feature of small and medium enterprises when compared to large enterprises. The owner creates his own relationship network with business partners, with whom they will realize marketing activities, which enhances possibilities for successful marketing decision making (p. 96).

Butigan and Mahnić (2011) discuss that small and medium enterprises marketing activities were, for very long period, observed from the aspect of traditional models, which were based on large enterprises practice, and therefore were considered as non-traditional, informal, short-term and non-strategic (p. 92) In domestic market conditions, marketing is commonly perceived as certain luxury which only large enterprises can afford, while small and medium enterprises usually conduct marketing activities occasionally and with as less funds as possible. This attitude may, to certain extent, be justified by the fact that, in initial development phase, entrepreneurial venture does not possess significant financial means. Therefore, entrepreneur takes responsibilities of a marketing expert, even though most commonly is not competent for this kind of business activities. However, in following phases of their development, marketing concept implemented by small and medium enterprises does not respond to classic perception of marketing activities organization. Considering the fact that enterprise must react to very dynamic market fluctuations and create its business activities in accordance with it, it can be concluded that it also has to create its marketing activities as a reaction to market fluctuations.

4. SURVEY RESULTS AND DISCUSSION

For the purpose of this paper, author has researched structure and organization of marketing activities application in small and medium enterprises on the territory of Republic of Serbia. Research was conducted during the period from February to April 2016 with a sample of 54 small and medium enterprises. By using method of random sampling and paying attention on the representativeness of the sample, results were obtained by applying questionnaire method. Criteria for research enterprise selection was based on The European Commission recommendation on enterprises definition (Recommendation 2003/361/EC, The Annex, Article 1 - Enterprise) "An enterprise is considered to be any entity engaged in an economic activity, irrespective of its legal form. This includes, in particular, self-employed persons and family businesses engaged in craft or other activities, and partnerships or associations regularly engaged in an economic activity". In accordance with this specification and relevant legislation in Republic of Serbia (Accounting Act "Official Gazette of Republic of Serbia"No. 62/2013), this research included small and medium enterprises from the territory of Republic of Serbia, which were classified in accordance with number of employees criteria.

Majority of data was gathered through the questionnaires which were completed by interviewees on their own, whereas representatives of six enterprises were interviewed. Research results were gathered by sending 490 questionnaires via e-mail to directors, owners or employees responsible for marketing sector or public communication. E-mail addresses were obtained by using Serbian Chamber of Commerce and National agency for regional development database. Level of responsiveness was 63%, or 34 completely

answered questionnaires. The rest of the results were gathered directly, by phone calls directed to employees who are responsible for public contacts as well as by interviewing representatives of certain business entities. Through empirical research, results which refer to structure and organization of marketing activities with the aim of gaining insight in domestic entrepreneurs' attitudes towards this business feature were obtained. Structure of enterprises included in this research is dominated by companies for production, trade and services (27,8%), companies from the sector of wholesale and retail (14,8%), enterprises from the field of civil engineering (20,4%), enterprises from the manufacturing industry (25,9%) and other fields (11,1%).

Results of the research indicate that the highest percentage of small and medium enterprises in Serbia conducts certain form of marketing activities, because 79,6% out of 54 enterprises which were included in this research confirmed that they use or were using certain marketing activities in order to enhance their business results. Within enterprises which confirmed their engagement in this sphere of business activities, 14% uses marketing agency services, while rest of them individually creates and realizes marketing activities. Furthermore, within enterprises which individually realize some forms of marketing activities, 43,2% of them claim that the owner of the entrepreneurial venture is responsible for realization of this type of projects, while 32,4% of the interviewees claim that within the enterprise there is an employee which performs marketing activities, besides its main tasks. Research results also indicate that even when an enterprise possesses an established marketing sector, employees in this sector do not have precisely defined responsibilities, and perform simultaneously more tasks. Besides creating and conducting promotional activities, they directly communicate with clients and are expected to attract new clients and broaden enterprise's business activities.

Research results have also indicated that owners of entrepreneurial ventures in Serbia do not conduct classic marketing activities, such as market research, due to the fact that they are considered expensive and indicators of underperformance in business. In accordance with this, owners of entrepreneurial ventures engage marketing experts only when they realize that certain market segments do not prefer or have negative attitude towards their products or services. Thereby, entrepreneurs usually impose their opinion to engaged external associates, expecting to achieve maximum results with as minimal possible investments. Therefore, they usually conduct marketing activities through different types of compensations or joint ventures with, for example, mass media with whom they later share economic profit form conducted activities.

Within enterprises which plan conducting of marketing activities, 25,6% of them possess formal marketing plan for their business, while rest of them create marketing activities as well as financial expenditure, i.e. marketing budget, optionally, i.e. in specific situations and from time to time. This can be confirmed by the information that only 16,3% of the interviewed enterprises which conduct marketing activities have precisely defined marketing budget. However, those funds are not significant because of the fact that most of the interviewed enterprises in Serbia claim that only 1 to 5% of total income is invested in marketing activities. Results of the research indicate that in small and medium enterprises marketing activities are treated in an informal manner and with significant influence of enterprise owner who determines the manner in which contact with customers will be established. Owners create direct relationship with customers and suppliers and develop their own marketing network because they consider that this kind of marketing is the most suitable for small and medium enterprises.

5. CONCLUSION

Theoretical and empirical research presented in this paper indicates that small and medium enterprises have simpler organizational structure when compared with large enterprises which have complex organizational structure. Small enterprises strive to centralization of organizational structure and business decision making, unlike large enterprises which apply decentralization in management process. As the enterprise expands its capacities, management conception is shifted from individual to collective or team management. Due to greater financial resources, large enterprises possess within its organizational structure special sectors for key functions and business activities such as marketing, finances, planning etc., which is not a characteristic of small enterprises due to lack of funds. Milošević et al. (2014) state that survival, growth and development of small and medium enterprises are primarily determined by funding opportunities from favorable sources (p. 519). Limited access to the sources of finance is probably the most important feature and the biggest issue of these enterprises which, to a large extent, defines their organizational structure.
Krivokapić and Jaško(2014) state that, due to small and medium enterprises specificity and their dependence on the specific conditions and situations, each one of them should be considered separately in one particular context (p. 1338). Therefore, small and medium enterprises differ due to: 1) individual

production or small batches production, 2) regional business orientation, 3) flexible organizational structure, 4) simpler management structure, 5) centralized organizational structure and 6) significant entrepreneur's influence that is usually the owner of small or medium enterprise. Small and medium enterprises specifics significantly influence organization of one of its key functions – marketing feature.

In the process of organizational structure construction, small and medium enterprises develop their structure through different phases. In initial development phase, sales feature of the enterprise is dominant. Nevertheless, direct contact between the owner and stakeholders, as well as development of proper marketing network is characteristic of initial development phase. Reason for paying that much attention to relationship with other market participants is because they affect, directly or indirectly, the results of all entrepreneurial ventures in the market. Continuous growth of small and medium enterprises initiates multidimensional development of marketing feature, that is sales as an operative function is being separated from other marketing activities, such as market research, promotion, product design enhancement, after-sales activities, etc. The aim of this paper is to stimulate discussion and further research about marketing development in small and medium enterprises in Serbian market, as well as to change perspective of domestic entrepreneurs towards conducting marketing activities with the aim of achieving best possible business results.

REFERENCES

Audretsch, D.,& Thurik, R. (2004). A model of Entrepreneurial Economy.*International Journal of Entrepreneurship Education 2(2)*, 143-166.Retrieved from: https://www.econstor.eu/bitstream/10419/19957/1/2004-12.pdf

Avlijaš, R. (2008). *Entrepreneurship and management of small and medium enterprises*. Belgrade, Serbia: University Singidunum.

Butigan, R.,&Mahnić, I. (2011). Role of relationship marketing in small and medium-sized enterprises. *Tržište, 23(1),* 89-104.Retrieved from: http://hrcak.srce.hr/trziste?lang=en.

Cvijanović, J. (2004). *Organizational changes*. Belgrade, Serbia: Economics Institute.

Deakins, D.,& Freel, M. (2012). *Entrepreneurship and small firms*. Belgrade, Serbia: Data Status.

Ferrell, O.C.,& Hirt, G. (1996). *Business: a changing world* (2nd ed.).Boston, USA: Irwin/McGraw-Hill. Gerber, M. (2010). *The E-Myth Enterprise: How to Turn a Great Idea into a Thriving Business*(1st ed.).New York, USA: HarperCollins Publishers.

Gibson, J., Ivancevich, J., &Donnelly, J. (1997). *Organizations: behavior, structure, processes*(9th ed.). Boston, USA: Irwin McGraw-Hill.

Gutić, D.,& Rudelj, S. (2009). Project-matrix models of marketing organization. *QMJ – Quarterly Marketing Journal, 40(4)*, 259-267.Retrieved from: http://readgur.com/doc/113453/%C4%8Dasopis-marketing--broj-40-4.

Hatten, T.S. (2014). *Small Business Management: Entrepreneurship and Beyond*(6th ed.). Boston, USA: Cengage Learning.

Hills, G.E. (1996). *Marketing and entrepreneurship research issues: Scholarly justification*. Chicago, USA: University of Illinois.

Jaško, O., Čudanov, M., Jeftić, M., &Krivokapić, J. (2013). *Designing organization*. Belgrade, Serbia: Faculty of Organizational Sciences.

Jaško, O., &Kostić, M. (1997). Project-matrix organization in marketing agencies. Paper presented at the YUPMA International project management symposium.

Kalinić, V. (1993). *Marketing logistics*. Subotica, Serbia: Faculty of Economics.

Kalinić, V., Ilić, S.,& Laketa, M. (2002). *Marketing of trade companies*. Belgrade, Serbia: Merkur.

Kotler P., Keller,& K.L. (2006). *Marketing Management*(12th ed.). New Jersey, USA: Pearson Education.

Kotler, P. (2001). *Marketing management: Analysis, Planning, Implementation and Control*(9th ed.). Zagreb, Croatia: Mate.

Krivokapić, J.,& Jaško, O. (2014*). Relationship between business environment and entrepreneurial activities.* Proceedings of the XIV International Symposium, New Business Models And Sustainable Competitiveness, Zlatibor, Serbia, 1332-1338. Retrieved from: http://symorg.fon.bg.ac.rs/proceedings/html/papers.html

Kuratko, D.F. (2014). *Entrepreneurship: Theory, Process, Practice*(9th ed.).Mason, OH, USA: SOUTH-WESTERN CENGAGE Learning.

Lovreta, S., Radunović, D.,& Kalinić, V. (1998). *Trade marketing*. Belgrade, Serbia: Faculty of Economics.

McGrath, H. (2008). *Developing a relational capability construct for SME network marketing using cases and evidence from Irish and Finnish SMEs*. Doctoral dissertation. Waterford: Waterford Institute of Technology. Retrieved from: http://repository.wit.ie/1053/1/Developing_a_relational_capability_construct_for_SME_network_marketing_using_cases_and_evidence_from_Irish_and_Finnish_SMEs.pdf

Milošević, N., Barjaktarović Rakočević, S.,& Milanović, M. (2014).*The Banking for Small and Medium*

Enterprises. Proceedings of the XIV International Symposium, New Business Models And Sustainable Competitiveness, Zlatibor, Serbia, 519-525. Retrieved from: http://symorg.fon.bg.ac.rs/proceedings/html/papers.html

Radić, N., Popović, J., Radić, V.,& Vukadinović, S. (2015). *Success and failure of entrepreneurial venture in Serbia through skills and competence of entrepreneurs*. Proceedings of International May Conference on Strategic Management - IMKSM2015, Bor, Serbia, 330-338. Retrieved from: http://mksm.sjm06.com/international-may-conference-on-strategic-management-imksm-2015-2/

Rakićević, Z., Ljamić-Ivanović, B.,& Omerbegović-Bijelović, J. (2014). *Survey on entrepreneurial readiness: management vs engineering students in Serbia, Relationship between business environment and Entrepreneurial activities*. Proceedings of the XIV International Symposium, New Business Models And Sustainable Competitiveness, Zlatibor, Serbia, 551-559. Retrieved from: http://symorg.fon.bg.ac.rs/proceedings/html/papers.html

Reijonen, H. (2010). Do all SMEs practise same kind of marketing?.*Journal of Small Business and Enterprise Development, 17(2),* 279 – 293. http://dx.doi.org/10.1108/14626001011041274

Scarborough, N.M. (2014). *Essentials of Entrepreneurship and Small Business Management*(7th ed.).New Jersey, USA: Pearson Education Inc.

Siropolis, N.C. (1995). *Small business management: A Guide to Entrepreneurship*(4th ed.). Zagreb, Croatia: MATE.

Sparling, K., Earls, G.,& Donath, B. (1994). *How to Evaluate and Improve Your Marketing Department*. Columbus, OH, USA: McGraw-Hill/Contemporary.

Vasiljev, S., Cvetković, Lj.,& Kancir, R. (2002). *Marketing management*. Subotica, Serbia: Faculty of Economics.

Vučenović, V., Zeremski, A.,& Lazić, J. (2009). *Success of a manager*. Belgrade, Serbia: Economics Institute.

Vukmirović, N. (2006). *Contemporary entrepreneurship, science and practice of business success*. Banja Luka, Bosnia and Herzegovina:Faculty of Economics.

APPENDIX

QUESTIONNAIRE

1. Does your enterprise conduct marketing activities within its business operations?
   - Yes
   - No
2. If the answer to previous question was affirmative, does your enterprise:
   - Independently creates and conducts marketing activities
   - Using the services of marketing agencies?
3. Who is responsible for conducting marketing activities in your organization?
   - Marketing expert
   - Employers who perform marketing activities besides their main occupation
   - Marketing sector
   - The owner
4. Does person who perform marketing activities has formal education or training in this area?
   - Yes
   - No
5. Who brings final decision about conducting marketing activities?
   - The owner
   - Marketing manager
   - Marketing sector
   - Other managers
6. Does your enterprise posess formal marketing plan with defined budget for marketing activities?
   - Yes, company has defined marketing plan and budget
   - Company has marketing plan, but budget is defined depending on the available funds
   - Company does not have marketing plan, activities are conducted depending on current needs
7. Which procent of total funds in invested in marketing activities?
   - 1-5%
   - 5-10%
   - 10-15%

WOMEN'S ENTREPRENEURSHIP - A GLOBAL PERSPECTIVE AND CURRENT STATE IN SERBIA

Maja Vrbanac*[1], Marina Milovanović[1], Jasmina Perišić[1]
[1] Faculty of real estate management, Union University Nikola Tesla, 62, Cara Dušana str., Belgrade, Serbia
* Corresponding author, e-mail: maja_radenkovic86@hotmail.com

Abstract: *This paper describes the current situation in the world and Serbia related to women's entrepreneurship. The goal of this work is to point out specific properties, development and challenges of women's entrepreneurship, The emergence of women entrepreneurs in the past twenty years in the developed world are closely linked to the democratization of society, namely, the equalization of men's and women's rights, particularly the right to education and access to economic and financial resources. Women's entrepreneurship is based on equal rights and inherent human dignity of women and men. Reducing the high unemployment rate of young women in the world and in Serbia can be achieved only by creating favorable conditions for the development of entrepreneurship. This will be achieved by improving the microeconomic business environment and ensuring the start-up capital. Primarily, it should create the conditions that would allow a safe and long-term development of their own business. Another important aspect of our study is women's education in formal and informal educational systems. Specific target skills and competencies precondition are necessary for any business enterprise, so it is important to arrange non-formal and continuing education directed to population of adult women.*

Keywords*: entrepreneurship, women's education, unemployment, the initial capital, gender equality*

1. THE EMERGENCE OF WOMEN ENTREPREUNEURSHIP

Affirmation of women entrepreneurship as a relevant objective of development of modern society, is supported by a number of international documents. The Beijing Declaration adopted in 1995 is the key document in which the integrated objectives and principles set out in the UN Charter, the Universal Declaration of Human Rights, in particular the Convention on the Elimination of All Forms of Discrimination against Women and, inter alia, the Declaration on the Right to Development. Women's entrepreneurship is recognized as an important mechanism for achieving equality, democratization and development of society, the preservation of peace and poverty reduction (Sarfaraz, Faghih, & Majd, 2014)(Duflo, 2012).

The phenomenon of female entrepreneurship includes all aspects, above all, that women want and need to reconcile family and professional obligations, bringing their personality and values into the business, and that their engagement in entrepreneurship is highly personalized (Rey-Marti, Tur Porcar, & Mas-Tur, 2015). Although there are more women in the population, employment of women is lower than male employment, women are the most present workforce at one of the lowest-paid sectors - services(Mitchelmore & Rowley, 2013), and there are very few women in leadership and management positions (Zlatkov Cvetković, 2015). Also, the average earnings achieved by women in relation to men are lower in almost all activities. From different studies we can find out that women who have entered the private business are generally well educated, their professional composition varies, most are married, with children, areas where they founded the private business mainly belong to traditional female occupations, thay rarely have their own start-up capital, and they form micro or small enterprises (Alam, Senik, & Jani, 2012)(Kalyani & Kumar, 2011). The reasons for starting a new business are the most common means of ensuring the existence of family and children and the desire to prove their own abilities (Gidarakou, 2015). The biggest obstacle they are facing are so called "Work on three fronts" (the household, the children/family care and work) (Vossenberg, 2013) and gender discrimination (Barsh & Yee, 2011).

In practice, women are often excluded from decision-making (Pines, Lerner, & Schwartz, 2010). Decision is reserved for small, informal, and as a rule, men's groups, which excludes women from institutional policy or diminishes their political power even when they are represented. Exclusion of women from institutional politics can slow down the democratic process generally and in the countries of ex-Yugoslavia. A particular problem to be solved is participation in public and political life of the multiple discrimination of women. There is more woman than men in the world, but in the economy, according to official information and indicators, they are minorities all over the world.

2. THE DEVELOPMENT OF WOMEN'S ENTREPREUNEURSHIP

Women's entrepreneurship, as a phenomenon of our time, bought very little attention until recently. The first important scientific paper on this subject appeared in 1976 (Schwartz, 1976) which drew attention to the upward trend of this kind of entrepreneurship. For example, according to statistics from 1972, about 4.6% of all US businesses are led by women. After investigations of the UN in 1995 two changes that have occurred in the last ten years have led to the establishment of a positive climate for the development of women's entrepreneurship

- Establishing legal and legislative equality for women;
- Ensuring equal access to vocational education and training for women.

Male resistance to women is stronger in Europe than in America. Polls in Italy and the UK have shown that nearly half of men reject the idea that women can perform manager tasks. Statistical analysis of the population of managers in the US and Western Europe has shown that women make up only 3% of CEOs of major companies and occupy about 12% of middle and lower management positions, even though they were in the labor force for more than 45%. In the literature, this phenomenon is explained by the existence of strong or impenetrable barrier, which is the result of a combination of all stereotypes (Huarng, Mas-Tur, & Yu, 2012). In the world there are three countries where women make up more than half of the employees (Ahl & Nelson, 2015).. This is Sweden (60% of employees are women), Canada and the US (52% of employees are women). The other extreme are countries of the Middle East in which the proportion of women in the labor force between 35% (Israel) and 4% (Iraq, Saudi Arabia). Unfortunately, one of the still strong reasons of meager representation of women in the management is their personal acceptance of "female roles" and from it emerged they are not interested in leading or managerial career.

In most cultures there is a strong division between male and female roles (Duflo, 2012). According to such cultural stereotypes that dominate, especially Arab countries, Latin America and the less developed regions of the world, managers can be only men. Women are expected to be subservient and dependent, not to stand out and to serve men. Even in developed democratic societies, where women enjoy formal equality, these cultural stereotypes are not completely eradicated. Different legal constraints that women are placed in a second-class status are only recently removed from the legislation of most developed countries, and in underdeveloped are still very much present (for example, Switzerland's did not have the right to vote until 1971, France had no regulation to protect women from harassment at work, and in the US women for the same job often receive lower wages than men).

However, things started to change in the 21st century. Between one quarter and one third of all businesses in the world today run by women with a growth rate up to two times, compared to the national average in the USA. Women are owners of approximately 30% of all businesses in the world. Entrepreneurs in developing countries now represent a vital driving force in all sectors of the economy, whether measured by the number of new jobs, the number of employees or the volume of realizing profits as shown in the following tables (Vukmirović, 2005).

Table 1: Women-owned businesses in the world (in %)

Country	Year	women-owned (%) enterprises
Netherlands	1992	8
Mexico	1990	9
Japan	1991	13
Germany	1993	15
Canada	1995	17
Australia	1994	18
US	1996	20

Table 2: New jobs launched or owned by women, from 2000 to 2010

Country	Started businesses owned by women (%)
Japan	23
Russia	64
China	25
Germany	34
Hungary	40
Poland	38
Mexico	32
US	38
United Kingdom	25
EU	33

When it comes to female entrepreneurship, there are countries in the world where the number of women entrepreneurs is lagging behind compared to the number of men, but there are also countries where women entrepreneurs grow:

- In the United States the rate of growth of women's enterprises, 2010. was twice the national average, and nearly half of the company is majority owned by women.
- In the UK, where the situation of women's entrepreneurship, according to the majority of analysts is pretty bad, 6.5% of all women of working age were employed in their own businesses. The share of women entrepreneurs is 26%, and this is a figure which has not been changed since 1990.
- In the countries of the European Union women lead 70% entrepreneurs of micro and small businesses with five or fewer employees.
- In the transition countries of Central and Eastern Europe economic position of women is largely deteriorated due to the reduction of the public sector, increased unemployment, greater job insecurity and the poor state of social welfare systems.

Most countries in transition do not pay attention to women's entrepreneurship. Most often it is represented in the less developed countries, where culture does not allow for the development of entrepreneurship. In these countries, there is still gender discrimination. In transition countries in financial crisis situations is the most hit by the female population (Pines et al., 2010), because they were the ones who would most often become out of work.

The difficult situation of women in the labor market in the countries of Central and Eastern Europe as well as in countries in transition is affected by various factors. Employers prefer to hire men and women are viewed as a labor force that does not guarantee stability in the business due to the fact that women are traditionally burdened with family and household chores. In addition, average unemployed women have a higher level of education than unemployed men. Most of them have secondary education, which means that they are not specialized to any particular area or skill. Overall opinion which prevails in countries in transition is that in terms of unemployment, men have more right to a job than women. Research shows that such thinking has: 55% of respondents in the Czech Republic and Poland, 42% in Hungary, 40% in Russia and 29% in Slovenia. This opinion is shared by 8% of respondents in Sweden, 11% in Denmark, 15% in Finland, 16% in Norway, 24% in the USA.

3. THE SPECIFICITY OF WOMEN'S ENTREPREUNEURSHIP

In all developed and traditional, patriarchal environments It is evident that women are at worse position, especially when it comes to property ownership (Duflo, 2012)(Vossenberg, 2013). It is a common practice when the inheritance of immovable property (land, houses, buildings) is under the cosideration women are expected their share of an inheritance to give to a brother or a male family member. When entering into marriage, as a rule, the right of ownership is transferred to the man, even in cases of joint construction or purchase of a house or apartment. By this women remains deprived of the right to dispose of their own property, or the right to run their own business, if there is a need for it, since there is not enough material resources, and they are not able to raise mortgage loans as a favorable alternative provision of financial resources. If a woman is financially dependent on someone else or doesn't have her own sources of income, she is likely to be on the margins of social events and without the possibility of active socialization.

It turned out that women are realistically discern, versatile thinking, and respect the opinions of others. Women hear better than men and faster adopt modern solutions. Thirty years ago barely, five percent of women were among the Masters of Science, and today women make up to between forty and fifty percent of participants specialized postgraduate business programs. According to some statistics, it is believed that women in Europe triggered or have been triggered every fourth new job. Many women have the creativity, the necessary expertise and skills necessary to start a new business, but often, unlike male entrepreneurs do not have equal access to credit, education and information, without which no successful conduct of business is possible(Witbooi & Ukpere, 2011). Like their male entrepreneurs, women entrepreneurs are highly educated, prone to taking risks and have developed an entrepreneurial spirit. There are several various motives conditioned by various factors for women starting their own businesses (Inić, 2007):

- The economic situation in the country - political contacts, corruption, crime, access to credit.
- Legal regulations - whether women have adequate legal assistance and access to information on the legal aspects of business;
- Cultural and social factors - traditions and patriarchal attitudes in society about who should be entrepreneurial.

Table 3: Women's and men's managerial qualities

"Women managerial qualities"	"Men's managerial qualities"
- Preference particular	- Abstractly
- The tendency of power-sharing and information	- Leadership through comparison and control
- Encouraging participation and cooperation	- Relying on the power situation
- Avoiding the risk	- Risk appetite
- Little tendency to superficial effects	- Little resistance to superficial impressions
- Orientation on mutual relations	- Orientation to action
- Network "family" structure	- Hierarchical, "military" organization structure
- Understanding of other people's behavior and problems	- Ignoring other people's personal problems and concerns
- Willingness recognition of personal mistakes	- Striving for hiding personal fouls
- The tendency harmonious relationship with the environment	- Willingness to conflicts and conflicts
- Emotional durability and resistance to frustrate	- The tendency of the explosion or "cracking" in crisis
- Greater self-control	- Smaller self-control
- Less hastiness	- Larger hastiness
- Stability in attitudes	- The tendency of changing attitudes
	- The exchange of services as a source of motivation
	- Analytical and rational problem solving

4. FEMALE ENTREPREUNEURSHIP IN SERBIA

On the labor market, statistics do not anticipate an unfavorable position of women in relation to men: from around 900,000 unemployed, 56 percent are women, but it is similar to their percentage share in the 1.9 million employees. (Zlatkov Cvetković, 2015) gives a qualitative review study of the perceived enabling factors for the female entrepreneurship in Serbia.

On the other hand, in Serbia, women are owners or co-owners of 16 thousand companies. This is the fifth of the total number of domestic companies. When these figures are compared with other countries, it is possible to conclude that Serbia already has a European average because even in Sweden, for example, there is no more than 22 percent of women entrepreneurs.

Unfortunately, a large number of companies in Serbia are only registered in the woman's name. More precise information is obtained when take into a consideration in how many companies woman is the wife of the owner and the manager of the same time, because then the more likely that they are present there only by name. By this criterion, according to data from the Agency for Business Registers, the women are manager in 6,700 small and medium-sized and 16 large companies in Serbia.

"Women's entrepreneurship in Serbia was mentioned ten years ago, when international aid programs were directed at women-refugees, as the most vulnerable category".Research suggests that as many as two-thirds of women who have a job, consider the woman in Serbia difficult to start a business because of the "Balkan syndrome". In one group of courageous women who have begun to engage in business, this percentage was reduced to a quarter. The principle is proverbial - who wants to do something - finds a way, who does not want - he finds an excuse.

So whether women themselves may give rise to men's frivolous understand the business? Often, they themselves are the victims of prejudice that could be "subject to" discrimination by males, women often do not have enough confidence to say, there is no authority to impose their views, and they fear that the reason for the loss of value in the eyes of men.

The fact is that in Serbia there are still traces of patriarchy, but it is not only a male (Zlatkov Cvetković, 2015). Do women begin to act more decisively, men will certainly not reject a good business proposition, just because it is sent by a woman. And that is the future of women's entrepreneurship, the future we must create and carve women. Any other approach would mean further loss of half of the intellectual capital, as a company and a country.

However the Statistical Office of the Republic of Serbia in its annual report of 2012 stated that the total number of employees (1.73 million), 1.34 million were employed in the companies, of which 626,000 were women. When it comes to entrepreneurs, they were 385.93410 or together with the employees, of which 171,000 were women.

When it comes to farming, women have been registered 28% of all farms. However, they make up only 23% of all individual farmers and 71% of unpaid family members in agriculture. In 2012, he was an almost equal number of those who would and who would not have started their own businesses, while men showed a greater willingness than women. It also has been shown that women with higher education show the greatest interest in the opening of a private business, where the youngest 47% of women do so if they have some features which confirms that entrepreneurial orientation with the younger generation to grow.

Based on information available from multiple sources, it is clear that the economic potential of women in Serbia is not used enough, either as a business owner or as a workforce. Comparative studies show that in 2007, among women aged 18-64 years, there were only 7.9% entrepreneurs. Recent studies from 2009 indicate that there were 14.9% of self-employed among women aged 15-64 years who are registered as employees.

5. SUPPORT MEHANISMS FOR GENDER EQUALITY AND WOMEN'S ENTREPRENEURSHIP IN REPUBLIC OF SERBIA

The National Strategy for Gender Equality (Republic of Serbia, 2016) is a basic strategic document of the Republic of Serbia, which shall be adopted with the aim of eliminating discrimination against women and achieving gender equality through the conduct of the equal opportunities policy for the period from 2016. to 2020. The strategy shall be adopted under the constitutional obligation of the State to guarantee the human rights provided by international treaties ratified, accepted rules of international law and the law of equality between women and men. It shall develop equal opportunities policy and it prohibits discrimination on any grounds, including that based on gender. Gender equality is a fundamental constitutional principle.

Gender Equality Law (Republic of Serbia, 2009) requires all public authorities to conduct an active policy of equal opportunities and to monitor the implementation of the principle of equality based on gender in all areas of public life and the implementation of international standards and the Constitution guaranteed law in this area. The strategy represents system of measures and policy instruments that the Republic of Serbia needs to implement in order to promote gender equality, fulfillment, respect and protection of women's human rights and the prevention of gender-based discrimination, especially against by certain persons or groups of persons belonging to vulnerable and multiply discriminated groups.

By creating, adopting and implementing the future national strategy for gender equality, the Government of the Republic of Serbia confirms their determination to persevere on the path of reforms that will ensure the full range of human rights of all citizens and complies with its obligations arising from the documents signed on the path of joining the European Union. Adoption of this Strategy is one of the priorities of the Republic of Serbia defined for the period from 2015. to 2018. in the National Program for the Adoption of the Acquis EU in 2014. - 2018 (European Integration Office, 2014).

In the period from 2016. to 2020, the state will focus on achieving the following general objectives in the policy of gender equality:

- Efficient use of sets of complementary gender-sensitive policies to promote exercise, respect and protect of the human rights of women.
- Gender equality is incorporated in all policies at all levels.
- Institutional mechanisms for gender equality is established and works effectively at all levels. The strategic objectives are aligned with the current policy documents, international standards of gender equality, the existing legal framework and the government's priorities defined in the National Program for the Adoption of the Acquis (2014 - 2018).

5.1. Motivations for women entrepreneurs

In our environment, it is known that the main motive of entrepreneurial business has a financial nature. There are still other factors of motivation of female entrepreneurship (Anuja, 2016) (DeMartino, Richard and Barbato, 2015):

- Dissatisfaction in large companies occurs due to various conflicts in the family, then layoffs, job responsibilities.
- The balance of family and work - for this reason more women are opting for smaller companies, because children cannot look after themselves.
- The desire to challenge - 44% of women entrepreneurs shows that when they began work, they realized that all they can do for the employer can do for yourself.
- Motivational differences.

Many analysts believe that women do not start big companies in order to satisfy their ego. They support each other. Researches have shown that men and women see success differently. While men see their success as achieving the objectives, women experienced success as a work that fills them, as well as control over their lives.

6. CONCLUSION

Female entrepreneurship is a reality and one of the main factors contributing to economic development in many countries. Political and economic changes in the past have created the possibility for women to set up companies and manage them. One possibility that is increasingly used today in countries with developed market economy, women control more than 25% of the total number of companies. Women represent more than one third of the total involved in entrepreneurial activity, while their participation in the informal sector of the economy is much larger. Generations of women in the world diverse heritage and education contribute to their environment and express very encouraging signs of entrepreneurial spirit. Women entrepreneurs have complex and keen sense of their management skills. They are better than men in giving new ideas, better in negotiating and convincing the interlocutor. Women are creative and responsible, self-confident, aggressive, goal-oriented, eager to be the first and only.

The potential of female entrepreneurship is manifested through a greater diversification between different economic sectors, younger entrepreneurs at the aggregate level, which means a greater number of business activities focused on the knowledge economy and production and lower concentration in the store. When starting the business the most important potential of women entrepreneurship is determined not to give up easily after the first attempt; The main disadvantages are a frequent entry into entrepreneurship because of the mere pressure of economic necessity and without sufficiently developed business ideas, while the obstacles are unfavorable resources to start, especially the lack of financial capital.

In most cases, entrepreneurs have expressed a conflict between business and family responsibilities, but this is usually not frustrating. On the contrary, they believe that they can manage to reconcile the two spheres of life. Their position in the family is more equal than that of the average for women in Serbia, and they are mostly satisfied with the lifestyle that goes with entrepreneurship.

It is necessary to establish a mechanism at the national level that would systematically deal with the many obstacles they face in their operations of micro and small businesses, particularly those owned by women. This certainly must be carried out in combination with progress in EU accession and adherence to the already accepted obligations from key EU documents such as the Small Business Act. Also, one must establish a time frame for each of the desired changes, in order to create a favorable and an enabling environment for doing business in Serbia.

In the future, more entrepreneurs would like to use membership in associations of business women, as well as recommendations of existing networks. There is a clear need for major improvements in the overall environment and the system in which micro and small businesses operate in Serbia. Particular attention should be given to sufficient and timely information to micro and small businesses. As is the practice in many countries, micro and small businesses are mainly about the state of the informal channels, but it is a challenge for providers of business services, which must be get closer to companies that use informal channels of information.

REFERENCES

Ahl, H., & Nelson, T. (2015). How policy positions women entrepreneurs: A comparative analysis of state discourse in Sweden and the United States. *Journal of Business Venturing*, *30*(2), 273–291. http://doi.org/10.1016/j.jbusvent.2014.08.002

Alam, S. S., Senik, Z. C., & Jani, F. M. (2012). An Exploratory Study of Women Entrepreneurs in Malaysia: Motivation and Problems. *Journal of Management Research*, *4*(4), 282–297. http://doi.org/10.5296/jmr.v4i4.2377

Anuja, S. G. (2016). Entrepreneurial Motivation and its Impact on Business Performance of Women Entrepreneurs with Reference to Chennai. *Indian Journal of Applied Research*, *6*(2), 26–29.

Barsh, J., & Yee, L. (2011). *Unlocking the Full Potential of Women in the U . S . Economy*. *Management*. Retrieved from http://online.wsj.com/public/page/women-04112011.html

DeMartino, Richard and Barbato, R. (2015). An analysis of the motivational factors of indending enterpreneurs. *Journal of Small Business Strategy*, *13*(2), 26–36.

Duflo, E. (2012). Women, Empowerment, and Economic Development. *Journal of Economic Literature*, *50*(4), 1051–1079. http://doi.org/10.1177/0002716297554001009

European Integration Office. National Program for the Adoption of the Acquis EU (2014). Retrieved from http://www.seio.gov.rs/upload/documents/nacionalna_dokumenta/npaa/npaa_eng__2014_2018.pdf

Gidarakou, I. (2015). Women's Entrepreneurship in Rural Greece. *International Journal of Business and Management*, *10*(10), 129–142. http://doi.org/10.5539/ijbm.v10n10p129

Huarng, K.-H., Mas-Tur, A., & Yu, T. H.-K. (2012). Factors affecting the success of women entrepreneurs. *International Entrepreneurship and Management Journal*, *8*, 487–497. http://doi.org/10.1007/s11365-012-0233-4

Inić, B. (2007). *Menadžment 1 –III izmenjeno i dopunjeno izdanje*. Beograd: Narodna biblioteka Srbije.

Kalyani, B., & Kumar, D. (2011). Motivational factors , entrepreneurship and education□ : Study with reference to women in SMEs. *Far East Journal of Psychology and Business Vol*, *3*(3), 14–35.

Mitchelmore, S., & Rowley, J. (2013). Entrepreneurial competencies of women entrepreneurs pursuing business growth. *Journal of Small Business and Enterprise Development*, *20*(1), 125–142. http://doi.org/10.1108/14626001311298448

Pines, A. M., Lerner, M., & Schwartz, D. (2010). Gender differences in entrepreneurship. *Equality, Diversity and Inclusion: An International Journal*, *29*, 186–198. http://doi.org/http://dx.doi.org/10.1108/02610151011024493

Republic of Serbia. Gender Equality Law (2009). Retrieved from http://www.ravnopravnost.gov.rs/images/files/zakon-o-zabrani-diskriminacije.pdf

Republic of Serbia. (2016). National Strategy for Gender Equality for the period from 2016. to 2020. Retrieved from http://www.mgsi.gov.rs/lat/dokumenti/nacionalna-strategija-za-rodnu-ravnopravnost-za-period-od-2016-do-2020-godine-sa-akcionim

Rey-Marti, A., Tur Porcar, A., & Mas-Tur, A. (2015). Linking female entrepreneurs' motivation to business survival. *Journal of Business Research*, *68*(4), 810–814. http://doi.org/10.1016/j.jbusres.2014.11.033

Sarfaraz, L., Faghih, N., & Majd, A. (2014). The relationship between women entrepreneurship and gender equality. *Journal of Global Entrepreneurship Research*, *2*(1), 6. http://doi.org/10.1186/2251-7316-2-6

Schwartz, E. B. (1976). Entrepreneurship-New female frontier. *Journal of Contemporary Business*, *5*(1), 47–76.

Vossenberg, S. (2013). Women Entrepreneurship Promotion in Developing Countries□ : What explains the gender gap in entrepreneurship and how to close it□ ?*Maastricht School of Management*, 1–27.

Vukmirović, N. (2005). Modeli podrške razvoju ženskog preduzetništva. *Industrija*, *33*(4), 1–18.

Witbooi, M., & Ukpere, W. (2011). Indigenous female entrepreneurship□ : Analytical study on access to finance for women entrepreneurs in South Africa. *African Journal of Business Management*, *5*(14), 5646–5657. http://doi.org/10.5897/AJBM10.1161

Zlatkov Cvetković, M. (2015). *Women entrepreneurship in Serbia*. SLU, Dept. of Economics.

ENVIRONMENTAL MANAGEMENT 530

ACOMPLISHING GOALS OF TERTIARY ENVIRONMENTAL EDUCATION BY USING DEBATE AS AN EDUCATIONAL METHOD 531
Vignjević Milan, Ćirović Marko

AIR POLLUTANTS AND GREENHOUSE GASES 538
Senegačnik Marjan, Vuk Drago, Petrović Nataša

APPLICATION OF EU LEGISLATION AIMED AT PREVENTING MAJOR ACCIDENTS IN THE CONTEXT OF ENVIRONMENTAL PROTECTION 546
Kovačić Mirjana, Zekić Astrid, Dundović Čedomir

COMBINING LEAN AND GREEN IN LOGISTICS: A SURVEY OF LOGISTICS COMPANIES IN SLOVENIA 552
Pejić Vaska, Lisec Andrej

ENVIRONMENTAL MANAGEMENT AND SUSTAINABILITY: TRENDS AND PRACTICES 559
Borojević Tatjana, Senegačnik Marjan, Petrović Nataša

MULTIATTRIBUTE METHODS AS A MEANS FOR SOLVING LAKE POLLUTION PROBLEMS 565
Andrić Gušavac Bisera, Popović Milena, Katić Ana

REACHING ENERGY EFFICIENCY THROUGH ENVIRONMENTALLY RESPONSIBLE HARDWARE AND SOFTWARE DEVELOPMENT 572
Milekić Matija, Ćirović Marko, Petrović Nataša

SELECTION OF EFFICIENT LOCATIONS FOR MEDICAL WASTES INCINERATION PLANTS 577
Stanojević Kristina, Makajić Nikolić Dragana, Savić Gordana

SUSTAINABILITY OF THE FASHION INDUSTRY: HOW DOES THE YOUTH FEEL 585
Radaković Jelena Andreja, Pepić Marko, Stevanović Dejana

THE ATTITUDES OF ENVIRONMENTALLY EDUCATED STUDENTS ABOUT A NEW GLOBAL DEVELOPMENT AGENDA 590
Petković Jasna, Radaković Jelena Andreja

ENVIRONMENTAL MANAGEMENT

ACOMPLISHING GOALS OF TERTIARY ENVIRONMENTAL EDUCATION BY USING DEBATE AS AN EDUCATIONAL METHOD

Milan Vignjević*[1], Marko Ćirović[1]
[1]University of Belgrade Faculty of Organizational Sciences
*Corresponding author, e-mail: vignjevic@ok.org.rs

Abstract: *Vast majority of educational systems are unsuitable to respond to modern needs, and their evolutions is very slow and lengthy process. We propose debate as a method of education, with focus on courses that study environmental issues, and in this paper specifically on its implementation within tertiary education. We argue that it would provide deeper understanding of the problems planet is facing, bring up the quality of the discussion about relevant issues; improve both awareness raising and solution finding. This paper will try to prove the relevance, urgency and necessity of adaptation of educational systems, unsuitable for Information age, age of man-made climate change and environmental catastrophes which became so often and expected that we can easily say "common" – we don't even report any more on so many of them. Efficient improvements are needed, and that is especially true for environmental literacy, which raises awareness – without it, we cannot hope to achieve the bare sustainability of our environment, while the ideal of "sustainable development" dispatches to some imaginary realm. Debate as a method is perfectly suitable to answer to these challenges.*

Keywords*: environment, ecology, education, debate, awareness, critical thinking, sustainable development*

1. INTRODUCTION

Back in 1962 Thomas Kuhn (Kuhn, 2012) said that our textbooks are more and more alike touristic brochures – fact not the way, neither the counter attitudes of scientists which were also experts by current paradigms. Simplification of knowledge and omission of context which established dominant approach, followed by next 50 years in which ex-cathedra approach dominated, along with the cult of the professor – established not necessarily by the authority of knowledge but position (Weber, 2009).

It is also important to note that current educational system main form is to create a class of educated people, ready to, through their participation in the market, contribute to general prosperity. Throughout the process, most of the historical evolution is based on specialization combined with market's pace and inherited urge to spread. This resulted in a simplification of science, solidified with our desire for better and faster understanding.

"Exactly that is the product of educational system we currently have. It simplifies the science by simplifying the participants in educational process: firstly, domain is defined, isolated from the context and from its historical background, then to its narrow area of interest, special logic is given. The result is vast majority of educational systems designed to tell what we have come to, as a conclusion, standard, unit of measure or a fact – not how we've done it" (Feyerabend, 1993). Educational systems around the world have, trying to make knowledge more accessible and comprehensible to students, have detached the discussion about facts and postulates on which most sciences are founded – that moved away the debate about postulates of sciences from majority of students. Furthermore, while that led to few but still, harmful impacts in some areas. In areas such as environmental studies, which are comparatively still young areas of science, and which postulates did not pass through decades and centuries of academic scrutiny it led to much greater number of harmful effects. Evidences suggest that ecology as a concept existed even in 4th century A.D. but it's recognition and following development happened only recently, in the eve of 20th century (Odum, Howard, & Andrews, 1971): in 1992 during the summit in Rio de Janeiro, United Nations came to "Rio Declaration on Environment and Development", term "sustainable development" was crafted for the first time, in Norway in 1989, adopted by European Union year later (Rodale, 2015).

Not until the last decade of 20th century, humanity has recognized importance and necessity of development of ecology as a science, and additionally that this area is a prerogative for even hoping to solve some of the imminent problems we have created. World had to deal with environmental catastrophes of 1960's to recognize necessity and finally recognize ecology as a science, and as field of expertise that is highly needed. Even these catastrophes were not enough for our collective realization of how big of the problem life

on planet faces, let alone that each and every of them proved that we haven't had developed any mechanism of how to respond to consequences.

Inclusion of youth in the problem solving process is predicament for achieving sustainable development (Cirovic, et al., 2014) as ecological problems require long term policies. Awareness raising and education of youth and general public is infallible. It is important in order for policies to work and be supported to maintain general public as equal member in a debate, both as a rational marker and as an expanding pool of inventors. But we need to make sure that policy makers, scientists and whole academic community are able to verbalize justifications, explain discoveries and theories and shape the discussion objectively, respectively.

Here where we come to another specificity of ecology as a science, unlike other that had "luxury" of taking several hundred years of building on their importance and paving their way to what we understand as common knowledge.

Regarding that society needs environmental knowledge now, this is why it is the focus of this paper to argue the change in the way ecology is taught, and to consequently change the way by and narrative in which ecological issues are discussed. It will be argued that debate is student-oriented method, and that is therefore more efficient, as it is proved to provide better acceptance of knowledge and its adoption (UNESCO, 2011).

2. DEBATE AS A METHOD

More than two millennia's ago, debate was already recognized as powerful method of teaching (Freeley & Steinberg, 2005). Ecology in this relationship – demands approach that can include and adopt different ecological philosophies in order to create possibility of understanding the problems and their complexity (Tumposky, 2004).

2.1.Academic debate

Most of the people understand debate as some form of a public discussion, exemplified in political duels or debates produced for broadcasting – which are still largely dominated by demagogy, logical fallacies and unsupported assertions. Debate as a method was crafted by a need for competitive debate, defined as: "balanced and fair communicational event on certain subject, with advocates on opposed sides whose speeches are going one after another, before verdict is reached" (Snider, 2011).

Debate requires academic discipline, accuracy, impeccable logic, and analytical explanation of assertions and argumentation. Reason founded on arguments rather than assertions and without leaps of logic is more persuasive – because it is simply more understandable. Communication founded in the idea of expressible argument that requires structured knowledge brings deeper and more profound understanding of the matter in question (Maloy, 1993; Toulmin, 1973).

2.2. Student oriented method

Debate is completely student-oriented method of teaching, and very efficient – as studies have shown that active role during the learning process in comparison to passive one (listening only), makes learning faster (Bonwell & Eison, 1991). Active learning has many definitions, but in general it should depict: the opportunity for students to talk and listen, discuss and reflect their thoughts about certain problem, idea or curriculum (Mayers & Jones, 1993). No teaching method is perfect as students learn differently and respond to different methods and incentives they provide (Snider & Schnurer, 2002) but study has shown positive correlation between student's engagement, critical thinking and student's grades, especially among students with lower average grades (Carini & Klein, 2006). Study supports debate and its usage in education because it requires engagement from students, research, articulation and argumentation of certain position or view (Dundes, 2001).

Research also shows that debate provokes engagement among passive students during lectures. For professors struggling with unprepared students, debate is offering reward of public presentation and fear of presenting unprepared to fellow peers, serves as a mechanism that brings responsibility back to students (Goodwin, 2003). Despite critics that say that preparation for debate is an additional burden, students that have debated on certain topics, show deeper level of understanding of that part of curriculum, which proves

that debate is useful to students, more than the other methods (Combs & Bourne, 1994; Vygotsky, 1978; Osborne, 2005).

Most importantly, debate offers the possibility for students to go further from basics of the subject they study, and advance their argumentation to levels of "higher critical thinking", which is necessary for a good debate. Debaters need to analyse, evaluate and synthesize knowledge to be able to argument certain attitude, to oppose it, or to be able to make certain strategic choices (Elliot, 1993). They have to apply acquired knowledge to create solid arguments, that need to be understandable and persuasive not only to professor – but to their colleagues as well (Cronin, & Glenn, 1991). This process develops and advances oral communication skills and active listening skills that are necessary to be able to respond to the arguments and case of the other side (Gorman, Law, & Lindegren, 1981; Allison, 2002).

3. IMPLEMENTATION AND SIGNIFICANCE

Importance of debate training was documented by monumental study (Malton & Keele, 1984) of ex-debaters, which proves affirmative link between competitive debate engagement and goals of higher education. Debate is one of the most successful methods of teaching because it is inherently interactive, and studies show that interactive formats are more efficient and give better results in development of critical thinking, cognitive learning, problem solving, attitude re-evaluation and improvement of communicational skills. Out of six recommended methods of active learning, debate uses five (Nyquist & Wulff, 1990).

3.1. Arguing both sides

As students are not choosing the side they will argue on the given motion. Teams positions are given to them, which means that, on average, students will have to argue position counter to their own. In everyday life arguing different positions of what you believed till that very moment would be considered and labelled as hypocrisy, and yet, we are to argue that that is essential, as it is fundamental difference between debate and other educational methods.

Debate is always a clash of values, principles and mechanisms to solve specific problem that already exists in our society (either in practical or intellectual or moral domain) and that involves the analysis of a status-quo, stakeholders, possible consequences and implications of establishing certain paradigms. Here we come to the first rule – debate motion (resolution) needs to be balanced, as there is no point in debating one sided motions, as presumption behind one sidedness is that we have already solved the problem in question.

Building arguments and constructing case for the opposite side of the one student would intuitively choose, makes them:

- Create arguments, re-evaluate facts and attitudes to support them;
- Makes them understand the position opposite to theirs, which necessarily makes them more tolerant because it makes them more likely to understand and be aware of merits, shortcomings and flaws of any of the sides;
- Leads to re-evaluation of postulates that are the core values proposed in a debate – which is by definition critical thinking;
- Demands from debaters to recognize and precisely define issues of relevance to the topic.

Accepting the flaws of one's own attitude is the first and necessary step towards gaining the credibility that is needed to influence, and eventually change someone else's attitude (Popper, 1972). If we know anything about ecological problems that humanity is facing, we know that they are controversial by nature – and while it is not the focus of this paper to examine that, it is worth to notice that students without debate training are much more likely to stay unaware of causes of this differences presented to us by nearly all of public discourse participants.

3.2. Problem definition and value of clash

Process of debating is focused towards defining the particular problem within the scope of the motion given, and explaining the potential value of one of the proposed solutions. From one perspective, debate presents the analysis of the practical implications of certain decision, but at the same time it brings clash of abstract principles and underpinning values that are foundation and starting points for proposing any policy or decision that changes status-quo.

Opposite to any discussion or other form of arguing, debate by its rules requires usage of structured knowledge, active listening, so that valid reply or counter argument can be formed. This tells us that after this approach to the studying process, personal attitude and view person holds in regard to different philosophies or views are free, informed and chosen. These views now emerge through evaluation of other views and philosophies, values or systems in comparative analysis.

For us, this represents the peak of our interest: that the informed choice, a point of view built on constantly re-evaluated arguments, and not learned doctrine – is how we need to educate youth about imminent ecological threats, different eco-philosophies, and everything which is within the scope of ecology.

3.3. Case building

Teams in the debate present their case, which in comparative with cases (case statements) of other teams in a debate are more or less persuasive, or simply said, believable. The debate is always judged on comparative, which is important because it instils the metric for evaluation in real problems we're facing in today's world. Idea, policy or measure cannot be accepted and implemented without contrasting pros and cons, as one would say in debate jargon. Pros and cons here define consequences that change in status-quo that measure inflicts in all adjacent spheres, whether it is legislative, or change in behaviour which changes social interactions or laws that inflict immediate change – none of it exists in a vacuum. This means that all of this needs to be taken into account when evaluating the quality and depth of analysis presented in a team's case.

That is why case building is important for us in the context of this paper and its aims; case building need to answer basic questions: who, what, how, and what are the conditions that create context in which this proposal occurs.

To define these, at the first glance, students need to be aware of very basic questions:

- What the real problem is and what stops us to solve it (contextualization)?
- Who and how is effected by the proposed solution (stakeholder analysis)?
- Is there a better alternative (justification of the proposition)?

While answering these questions and trying to synthesize them in their case, students are well aware that every stance has a set of principles that are upholding it. Here we have to emphasize that this is when evaluation of known ecological philosophies, their values and perspectives come in play. They are not detached from students, nor obscure dogmatic definitions or contemplations, they become real through synthesizing knowledge as a platform from which arguments, attitudes and proposals are risen – and the gap between students and process of establishing scientific "truth" is narrowed if not closed – as they gain agency to play the main role in it. They become equipped with skills previously unavailable to them, which secure more profound understanding of matters in question.

4. CONCLUSION

Back in 1975, one study (Huseman & Goodman,1976) discovered that 55% percent of the U.K. Parliament attended some training in competitive debate, out of which outstanding 87% claimed that debating helped them in their professional carriers. No evaluation of debating as an educational activity was negative. This result, that may be surprising as we are back in the day looking at the world in which very few countries had a debate program, apart from the Commonwealth, and that even if they have had it, it was considered to be an extracurricular activity. Nevertheless, studies of Schroeder and Schroeder in 1995 have confirmed this – debating has a positive effect on person's professional development; skills they use they credit to debate, not university education. There are strong empirical evidences that debating teaches crucial skills – it inevitably advances communicational skills; offers unique techniques for complex analysis of current affairs in almost any sphere of human endeavour; focused critical thinking; improves probability of success in pursue of professional success. (Colbert & Biggers, 1985). Out of 100 people more than 90 believes that debate helped them in their professional career – and that is an outstanding score of recognition (Klopf & Lanham, 1967).

If we return all of these studies back to context, and if we remember that when most of them were done, we didn't even have ecology as a recognized science. This fact should alter the conversation: studies, research, and evaluation – all was done in context in which everything was different - world had no knowledge about how serious and fast we destroy our environment. We didn't have Internet – which means that we have had limited access to information, less accessible knowledge, and last but certainly not least, different and slower

communication. Skills that debating as activity develops, and mechanisms and requirements it imposes as educational method – were desirable, but now they are necessary.

It is also very important to note that today students are overloaded with information and data, and they need to be trained, and equipped with skills that would allow them to assess information they receive instantly, and to be able to do proper evaluation through research.

This, in context of this paper, means that when so called experts give side opinions and publish researches that diverge from what was established as problematic or worrying, they need to be able to see whether it was done because of pursuing scientific truth, or because there were other interests in place. We need to remember that even in 21st century we still have spokesmen of various industries (oil industry first and foremost) who not only actively underestimate damages done to the environment, but even go as far to disprove that human activity has any influence on it. That being noted – importance and relevance of critical thinking being trained and practiced during studies is clearly immense.

Intrinsic motivation for learning, that comes with honest satisfaction for the acquirement of new knowledge and widening of awareness spectrum is very rare to be seen in current educational systems. Motivation, that is driven from personal, inner goals, not by outer demand or even recognition – is the strongest and best motivation for process of learning. If you have students motivated in this way, implementation of high standards in educational system and their achievement becomes an easy process (Ames, 1992). As mentioned earlier, debating offers exactly that urge – in order to win, and represent yourself in the desired manner , you need to be better; in other words, you really need to know and understand what you are about to argue. That is where the inner motivation comes from, for a person to appear, especially in front of your peers, credible. Debate being specific as it was argued before in this context, unlike any other form of discussion, it is based on argumentation, not demagogy or rhetoric. So for student to be able to accomplish this goal really needs to know, understand, and learn how to show this in the best possible manner; it doesn't enable credibility to appear where there is no proper argumentation.

This is very important to notice, for acceptance and adoption of ecological values, principles and behaviour today, more than ever before: societies have need for high quality ecology education programs, which with success are raising the system of values, and change behaviour in direction of sustainability, by promoting conservation and appraisal of protection of environment and nature (Petrovic, 2012).

Accomplishing goals of United Nations infamous "Agenda 21" is completely compatible with proposed method of education. If a team proves that their proposal leads to better world, even if it is just an incremental improvement, then they win. Same is true in a debate, and as a reiteration, that is the biggest difference in narrative that this method would provoke, because it changes the goal of educational system. It is not teaching "facts that need to be preserved" no more, because it establishes a consensus that we are willing to change or challenge facts if we are to believe that that would mean an improvement. This is what is a necessity for achieving "ecological literacy" , that needs to be brought back to the processes of coming to scientific facts and achieving both academic and social consensus back to our education, if we want people to understand and adopt the changes in their lives necessary for our environment's sustainability (UNEP, 1992).

Lastly on this: level, depth and quality of acquired knowledge, as we have seen rise rapidly among students who had debate on the motion that covers certain area of studies. This is very easy to explain: people think in greater depth when they need to explain something to someone else. Debate requires that process to be impeccable, without any logical fallacies or shortcomings of elaboration, and persuasiveness – which demands that assertions and arguments be related to the audience. This produces both understanding and analysis that is incomparable to any other educational method used today. If we apply the rules of competitive debate, in which no usage of electronic devices is allowed during the preparation time, this method makes students perfect agents to enact change.

Change in narrative surrounding ecological issues, questions and problems is of utmost importance if we want all relevant actors to be included, ecology as a science simply doesn't have the luxury of becoming detached from general public, of becoming prestigious in any manner. This is prerogative for ecology education, since we had too many doubts loudly presented to us by scientists, politicians, experts: we came to consensus that human activity does cause global warming, only at the beginning of 21st century, and there is still incomprehensibly huge amount of people that reject that notion. Hence, as Schopenhauer argued, dialectic way is the most efficient tool of coming to realization; which can be especially true when having, as today, an overload of information (Schopenhauer, 2008).

Conclusion is that this method, integrated in education, promotes ecological literacy and development of skills that are necessary for life learning. This fosters efforts not only to engage general public in discussion about our environment, while it raises general conciseness and knowledge about ecological problems and environmental threats that we are causing (Petrovic, Jeremic, Petrovic, & Cirovic, 2013). Processes that are integrated in academic debate as a form of problem-solving mechanism, inherently require critical thinking, and decision making skills in general – this is what we need to strive for, in order to grow into population that will be aware of environmental problems (Petrović, Išljamović, Jeremić, & Drakulić, 2011), and that will consciously make decisions concerning ecology, or in other words – sustainability. This ought to be our imperative if we are to strive to ideal of sustainable development. (Petrovic, et al., 2013).

REFERENCES

Allison, S. (2002). Debating with talented and gifted students. School Libraries in Canada, 22(1), 13-14; Combs, supra note 26.

Ames, C. (1992). Achievement goals and the classroom motivational climate. In D. H. Schunk &J.

Bonwell, C., & Eison, J. (1991). Active Learning: Creating Excitement in the Classroom. Washington, D.C.: JosseyBass.

Carini, R., Kuh, G., & Klein, S. (2006). Student engagement and student learning: Testing the linkages. Research in Higher Education, 47(1), 1-Carini, R., Kuh, G., & Klein, S. (2006). Student engagement and student learning: Testing the linkages. Researchin Higher Education, 47(1), 1-32. 32.

Cirovic, M., Petrovic, N., & Slovic, D. (2014). EPI: Environmental Feedback on the Organization's Sustainability. Innovative Management and Firm Performance: An Interdisciplinary Approach and Cases, M. Levi-Jaksic, S. Barjaktarovic-Rakocevic and M. Martic (eds.). Palgrave Macmillan: London.

Colbert, K., & Biggers, T. (1985). "Why Should We Support Debate?" Journal of the American Forensic Association 21 237-40.

Combs, H., & Bourne, S. (1994). The renaissance of educational debate: Results of a five-year study of the use of debate in business education. Journal on Excellence in College Teaching, 5(1), 57-67 (reporting 78% of the 544 students in a senior level marketing class reported learning more by debate than lecture);

Cronin, M., & Glenn, P. (1991). Oral communication across the curriculum in higher education: The state of the art. Communication Education, 40(4), 356-367 (noting through surveys the perception of business leaders about inadequacy of communication skills among undergraduates).

Dundes, L. (2001). Small group debates: Fostering critical thinking in oral presentations with maximal class involvement. Teaching Sociology, 29(2), 237-243.in Higher Education, 47(1), 1-32.

Elliot, L. (1993). Using debates to teach the psychology of women. Teaching of Psychology, 20(1), 35-38;

Feyerabend, P. (1993). Against method. Verso.

Freeley, A., & Steinberg, D. (2005). Argumentation and debate: Critical thinking for reasoned decision making (11th ed.). Belomont, CA: Wadsworth.

Goodwin, J. (2003). Students' perspectives on debate exercises in content area classes. Communication Education, 52(2), 157-163.

Gorman, M., Law, A., & Lindegren, T. (1981). Making students take a stand: Active learning in introductory psychology. Teaching of Psychology, 8(3), 164-166.

Huseman, R.C., & Goodman, D, M. (1976). "BYD congressional questionaire," Journal of the American Forensic Association, Vol. 12, 225- 228.

Klopf, D.W. & Lanham, C.P. (1967). Coaching and Directing Forensics. Skokie, IL: National Textbook.

Kuhn T. S. (2012). The structure of scientific revolutions. University of Chicago press.

Maloy, K. (1993). Toward a new science of instruction. Pittsburgh, PA: National Research Center on Student Learning.

Matlon, R. J., & Keele, L.M. (1984). A Survey of Participants in the National Debate Tournament, 1947-1980. Journal of the American Forensic Association 20 194-205.

Meyers, C., & Jones, T. (1993). Promoting active learning: Strategies for the college classroom. San Francisco:Jossey-Bass, p. xi.

Nyquist, J.D., & Wulff, D.H. (1990). Selected Active Learning Strategies in Teaching Communication: Theory, Research and Methods. Eds. John A. Daly, Gustav F. Frederich, and Anita L. Vangelisti. Hillsdale, NJ: Lawrence Erlbaum.

Odum, E. P., Howard T. O., & Andrews, J. (1971) Fundamentals of ecology. Vol. 3. Philadelphia: Saunders.

Osborne, A. (2005). Debate and student development in the history classroom. New Directions for Teaching and Learning, 103, 39-50.
Petrović, N. (2012). Environmental management – second edition. Faculty of Organizational Sciences: Belgrade,
Petrovic, N., Isljamovic, S., & Jeremic, V. (2013). A new concept for measuring achievement levels in higher environmental education. Energy Education Science and Technology Part B-Social and Educational Studies,5(2), 809-818.
Petrović, N., Išljamović, S., Jeremić, V., & Drakulić, M. (2011). Towards framework for higher environmental education. Management- Journal of management theory and practice.16(60), 11-17.
Petrovic, N., Jeremic, V., Petrovic, D., & Cirovic, M. (2013). Modeling the use of Facebook in environmental higher education. The Social Classroom: Integrating Social Network Use in Education: Integrating Social Network Use in Education, 100.
Popper, K. R. (1972). Objective knowledge: An evolutionary approach: 81-106.
Rodale Institute. (2015). Retrieved from: http://www.rodaleinstitute.org.
Schopenhauer, A. (2008). The Art of Being Right. Dodo Press.
Snider, A. C. (1984). DEBATE: Important for Everyone"; essay; American Forensics in Perspective. Papers from the National Conference on Forensics (2nd, Evanston, Illinois, September 12-15, 1984) [microform] / Donn W. Parson, Ed
Snider, A., & Maxwell S. (2002). Many sides: Debate across the curriculum. IDEA,
Toulmin, S. (1973). Human understanding, Vol. I: The collective use and evolution of concepts.
Tumposky, N. (2004). The debate debate. Clearing House, 78(2), 52-55.
UNESCO, UIS. (2011). Global education digest 2011. Comparing education statistics across the world.
Vygotsky, L. (1978). Mind in society: The development of higher psychological processes. Cambridge, MA: Harvard University Press.
Weber, M. (2009). From Max Weber: essays in sociology. Routledge.

AIR POLLUTANTS AND GREENHOUSE GASES

Marjan Senegačnik[1], Drago Vuk[1] Nataša Petrović[2]
[1]Faculty of Organizational Sciences, University of Maribor, Slovenia
[2]Faculty of Organizational Sciences, University of Belgrade, Serbia

Abstract: *The purpose of this paper is to discuss some facts about air pollutants and greenhouse gases. Nevertheless both groups of substances are related and often derive from the same sources these two terms should not be confused. However, it seems that this often happens in discussions. Therefore, the intention of this paper is to present the main air pollutants as well as the most important greenhouse gases and their environmental impact. At first the impacts of air pollutants on air quality and their possible adverse effects on health are briefly discussed. Special emphasis is given to the role of some of the most important pollutants as are ground level ozone, particulate matter, carbon monoxide, nitric oxide, nitrogen dioxide, sulphur dioxide, hydrocarbons and lead. The main features of greenhouse effect are also briefly shown as well as the role of some the most potent greenhouse gases as are carbon dioxide, methane, chlorofluorohydrocarbons, ground-level ozone and nitrous oxide. Additionally, the relation between both groups of substances and certain ambiguities regarding this problem are briefly discussed. It is important to take care of adequate understanding of terms of air pollution and greenhouse effect in environmental educational programs.*

Keywords*: air pollutants, greenhouse gases, atmospheric pollution, global warming, environmental education*

1. INTRODUCTION

Atmospheric pollution results from various human activities (energetic, industry, traffic etc.) and presents an outstanding problem for decades. For a long time this problem was connected mainly with the aggravated air quality in urban environments as well as in industrial areas. In last two decades increasingly more attention is devoted also to the greenhouse effect which is recognized as the reason of global warming and undesired climatic changes. However, it seems that there is often some ambiguity in publicity when discussing these two problems. Nevertheless both problems derive often from the same sources and certain substances behave both as pollutants as well as greenhouse gases these two terms should not be confused.

In the last decades increasingly more attention is concerned to incorporate awareness about air-pollution into educational programs from the elementary school level up to the universities. The intention of these programs is to improve the basic comprehension of air pollution topics and to rise environmental awareness. Students should recognize the possibilities how to reduce the level of pollution and environmental degradation (Petrović, 2009, p.205). In addition to this should be mentioned more goal oriented programs designed for people suffering from some chronic diseases which are particularly sensitive to air quality as are by example asthmatic patients (Dorevitch et al., 2008). On the other hand the greenhouse effect and its consequences as are global warming and undesired climatic changes seem to become in the period after 2000 one of the most highlighted problems not only from an environmental point of view, but generally. People have become aware of the problem and also of possibilities of reducing greenhouse gases emissions. However, there still certain lack of understanding of physical and chemical processes connected with both air pollution and greenhouse effect can be found even among university students. Therefore both phenomena are often confused.

2. AIR POLLUTANTS

As air pollutants are classified all substances present in the air which are harmful to the human health and/or have some negative impact on the environment. Some of these substances can be present in the atmosphere also according to some natural processes as are forest fires, volcanic eruptions, organic matter decay etc. As such events often happen accidentally these substances are not normal components of the air. They are sometimes also named accidental components of the air as they appear in the atmosphere occasionally and their concentration in air is quite variable (Lazarini and Brenčič, 1984, p. 270; Oxtoby et al. p.99, 1999). However, according to pollution caused by human activities these substances are often continuously present in the atmosphere particularly in urban areas and industrial regions. This is connected with aggravated air quality and adverse effect on the health of the people living in these areas. The adverse effects of these substances are not always limited to the neighbourhood of their formation as they can be

transported by air flows on considerable distances – sometimes even several thousand kilometres. Therefore the control of air pollution is not only the problem of individual countries but it should be the subject of international cooperation. Into this purpose in 1979 the Convention on Long-range Transboundary Pollution was introduced (ARSO, 2016; UNECE, 2016.)

The following substances are submitted under the control (ARSO, 2016):

- Basic pollutants: sulphur oxides (SO_x), nitrogen oxides (NO_x), non-metane volatile organic compounds (NMVOC), ammonia (NH_3) and carbon monoxide (CO).
- Particles: particulate matter with diameter under 10 µm (PM 10), particulate matter with diameter under 2,5 µm (PM 2,5), total suspended particles (TSP) and black carbon
- Heavy metals: lead (Pb), cadmium (Cd) and mercury (Hg)
- Stable organic pollutants: polyaromatic hydrocarbons (PAH), dioxins and furanes (PCDD/PCDF), polychlorinated byphenils (PCB) and hexachloro benzene (HCB).

Similarly, also Clean Air act in United States requires Environmental Protection Agency to set EPA standards for six common pollutants – which are often named also “criteria” pollutants are (EPA, 2016 a):

- Ground level (tropospheric) ozone
- Particulate matter
- Carbon monoxide
- Nitrogen dioxide
- Sulphur dioxide and
- Lead.

Six main pollutants according to EPA are schematically shown in Figure 1.

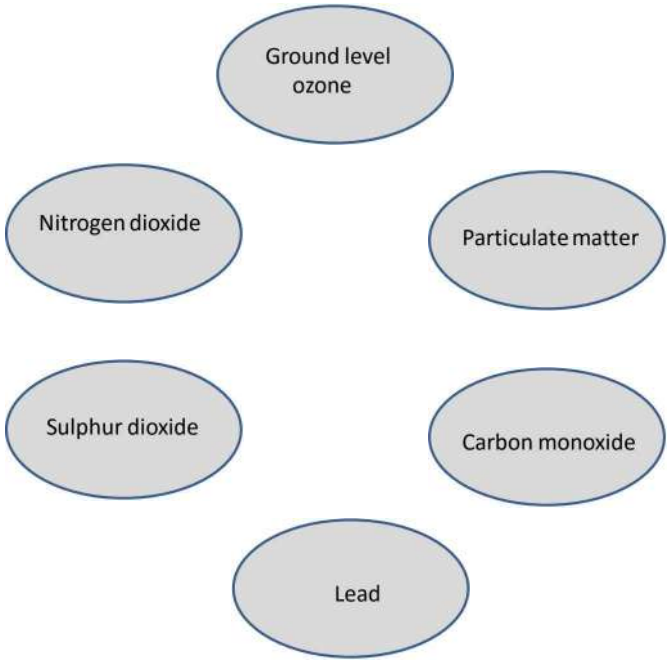


Figure 1: Six main pollutants according to EPA standards (EPA, 2016a).

Pollutants which concentrations in the air are regularly monitored in Slovenia are (ARSO, 2015):

- Particulate matter (PM 10 and PM 2,5)
- Ground level ozone
- Nitrogen oxides
- Sulphur dioxide
- Carbon monoxide and
- Hydrocarbons (Benzene).

Some main properties and adverse effects of particular pollutants are briefly discussed bellow.

Ozone

Ozone (O_3) is three atomic modification of oxygen. Unlike ordinary (two atomic) oxygen which is odourless and colourless gas ozone at normal conditions is blue gas with a pleasant odour. Ozone is strong oxidant and therefore chemically reactive substance ((Lazarini and Brenčič, 1984, p. 273). Ozone is harmful mostly for the respiratory system but also to cardiovascular system (Goudarzi et al., 2015). Its adverse effects affect particularly more sensitive parts of population like children and patients suffering from asthma. Ozone exhibits also negative impact on plant growth (Proietti et al., 2016).

When discussing ozone problems it is necessary to distinguish between stratospheric ozone (named also "good" ozone) and tropospheric or ground level ozone (named also "bad" ozone) (EPA, 2016a). It should be emphasized that in both cases this is the same substance – the difference exists only according to the position in the atmosphere.

Stratospheric ozone: Over 90% of ozone naturally is located in the stratosphere – actually between 15 to 20 km above sea level. Stratospheric ozone has no adverse effects as it cannot be breathed, but it has important role by absorbing harmful UV-B radiation. This ozone layer is called also ozone shield due to its protective effect. Ozone concentration in the stratosphere decreased in the last decades due to intensive use of chlorofluorohydrocarbons (CFC) in sprays, refrigerators etc. This effect is known as ozone holes and results in enhanced UV-B radiation intensity at the earth surface.

Ground level (tropospheric) ozone: In troposphere ozone naturally is not common. Ozone is formed by electrical discharging – for example by lightning. However, in polluted air ozone is formed as a by-product in photochemical reactions taking between nitrogen oxides and hydrocarbons. In the troposphere ozone cannot have any protecting role absorbing UV radiation but its negative impacts on human health and other living organisms are expressed. Ozone presents one of the most problematic pollutants in the last period. Its concentration raised particularly in summer as in hot sunny days there are very favourable conditions for photochemical reactions (ARSO, 2015). As ozone is not component of any exhaust gases but it is formed in the troposphere by reaction between other pollutants (nitrogen oxides and hydrocarbons) it is designated as secondary pollutant.

Particulate matter

Particulate matter or particulates include various solid particles which can have different chemical composition. They can derive booth from natural processes as well as from anthropogenic sources. Particularly problematic are soot particles resulting from incomplete fuel combustion often called also black carbon particles. They derive from various sectors as are traffic, energetics, industry and individual heating devices. Particulates are ordinarily divided into two classes:

- PM 10: particles with diameter less than 10 µm and
- PM 2,5: particles with diameter less than 2,5 µm.

Particulates present probably the most problematic kind of pollutants. They are the main reason for low air quality in urban areas and have been recognized as a reason for a great number of premature deaths. Contrary to the ground level ozone which is problematic particularly in the summer elevated concentrations of particulates are common in the cold part of the year (ARSO, 2015).

It is not surprising that PM 2,5 particulates are more dangerous as due to its smaller size they more easily penetrate into respiratory system. Particles generated by incomplete combustion (black carbon particles) are more problematic than particles deriving from other sources. Both short-term and long-term exposure to particulates results in health problems. Adverse effects can be observed on the respiratory tract (asthma, lung cancer) as well as on the cardio-vascular system (WHO, 2013; Simoni et al. 2015).

As one of the most problematic sources of particulate matter diesel (compression-ignition) engines have been emphasized which produce incomparably higher emissions of particulates than conventional petrol (spark-ignition) engines. Therefore, EURO emission standards determined permitted level of PM emissions for vehicles with diesel engines. The use of particulate filter is often necessary to fulfil the requirements of standards. However, the modern petrol engines with direct injection of fuel express even higher PM emissions than diesel engines and thus EURO 5 and 6 standard series also determine permitted PM emissions for direct injection petrol engines (Dieselnet, 2015).

Sulphur dioxide

Sulphur dioxide (SO_2) is generated by combustion of sulphur which is present in various fossil fuels (carbon, oil derivatives). Sulphur dioxide is at normal conditions colourless gas which is not poisonous but exhibits choking effect as well as irritating effect on mucosa and respiratory tract. Therefore elevated concentrations of sulphur dioxide in the air are harmful for living organisms. Sulphur dioxide is also important as acid rain precursor. (Lazarini and Brenčič. pp. 314-315).

Nitrogen oxides

Nitrogen oxides present a group of seven different compounds. All nitrogen oxides except nitrous oxide (N_2O) are toxic. Nitrous oxide is a green-house gas and will be briefly discussed in the following chapter. When discussing air pollution two other nitrogen oxides are important: nitric oxide (NO) and nitrogen dioxide (NO_2). They are often together designated as NO_x.

Nitric oxide (NO) is at normal conditions colourless gas. Nitric oxide is synthesised by high temperatures from nitrogen and oxygen which are constituents of air. Nitric oxide plays certain role in human metabolism where it serves as cellular signalling molecule and shows vasodilation effect (Abrams, 1996). However, its concentrations are recommended to be kept bellow 25 ppm (30 mg per m^3). At higher concentrations irritating effects on eyes, skin and respiratory system can be observed. Concentrations of NO above 100 ppm are immediately dangerous for life (CDC, 2011).

In air nitric oxide is oxidized to nitrogen dioxide. Nitrogen dioxide (NO_2) is at normal conditions brown gas. Nitrogen dioxide is poisonous gas which affects particularly respiratory tract. Exposure to nitrogen dioxide can lead to respiratory problems and lungs function decrease (WHO, 2003). Beside direct adverse effects nitrogen dioxide is problematic also as precursor of tropospheric ozone and acid rain.

Contrary to nitrous oxide both nitric oxide and nitrogen dioxide does not have an important direct greenhouse effect. However, as precursor of tropospheric ozone it contributes indirectly to global warming.

Carbon monoxide

Carbon monoxide (CO) is colourless and odourless gas. Carbon monoxide is result of incomplete combustion of fuels. It is extremely toxic due to its tendency for binding on hemoglobin where it prevents binding of oxygen. High concentrations of carbon monoxide can cause death what is especially dangerous in closed space. In external space the situation is not so critical however elevated carbon monoxide concentrations reduce oxygen delivery to the tissues. This can affect particularly people suffering from ischemic heart disease (EPA, 2016a).

Hydrocarbons

Hydrocarbons (HC) sometimes also designated as volatile organic compounds (VOC) or non-methane volatile organic compounds (NMVOC) are present in the air due to various reasons – they derive from traffic, energy sector, individual heating devices, industry etc. Automotive emissions present an important source of hydrocarbons, by example both petrol and diesel fuel contain mixtures of various hydrocarbons. These compounds to certain extent leave engine unburnt – in original form or only partly changed. More than hundred different hydrocarbons have been detected in the analysis of automotive exhaust. The majority of these compounds show some irritating effects but some of them (by example benzene) are carcinogenic (Mondt, 2000).

Lead

In addition to the kinds of pollutants listed above also some other pollutants are problematic as are heavy metals. As mentioned EPA standards include among six main pollutants also lead. Lead exhibit various negative affect on human organism affecting immune system, kidneys, cardiovascular system and nervous system. Lead is even in relatively low levels particularly harmful for developing nervous system in children and youth. Lead presence in the air derives mainly from metal processing, aircraft engines, waste incinerators and lead battery manufacturing. Lead was in the paste widely used for the rising of octane number of petrol. Therefore lead tetraethyl or lead tetramethyl were added to petrol. However after introduction of catalytic converters the use of lead compounds was abandoned and aromatic compounds are now used for improving the fuel octane number. According to the EPA data concentrations of lead in the air in USA decreased in the period 1980-2014 for 98 per cents (EPA, 2016 a). In European countries catalytic converters have been introduced in the beginning of 1990s. Therefore also leaded fuel use was abandoned slightly later – in Slovenia in 2001. In spite of this fact it does not happen so rarely that in some environmental discussions automotive emissions are still wrongly stated as source of lead emissions.

3. GREENHOUSE GASES

Greenhouse effect is caused by the fact that in the atmosphere exist certain substances which molecules are capable of absorbing infrared light. In such way these substances which are designated as greenhouse gases retain heath in the atmosphere. Greenhouse effect is to certain extent natural phenomena which is necessary condition that the life on the Earth is possible. Without any greenhouse effect the temperature on the Earth surface would be about 30 °C lower as it is and there would be very large fluctuations in the temperature. Therefore the greenhouse effect itself is by no means problematic. The problem exists in additional human contributions to the greenhouse effect – so called anthropogenic greenhouse effect. The main factor contributing to the natural greenhouse effect is water vapour. However in the case of water vapour there exists very efficient natural temperature regulation – when air becomes saturated with water vapour the excess vapour simply condenses. Therefore any human activity cannot increase the water vapour concentration in the air. However in the case of the other greenhouse gases there does not exist such regulating mechanism. This is the reason that concentration of these substances increased considerably in the past decades enhancing the ability of atmosphere to retain heath. This is believed by many scientists to be the reason for global warming and undesired climatic changes.

Substances contributing to the anthropogenic greenhouse effect derive mainly from the same sources as the air pollutants. Some substances also take both roles – as air pollutants and greenhouse gases. Nevertheless both roles should not be confused. In the case of classical pollutant the problem exists in the fact that substance is either poisonous or on some other way harmful to humans or other living organisms. In the case of greenhouse gases, however, the problem exists in the ability of substances to retain heath in the atmosphere. The contribution of the various gases to the anthropogenic greenhouse effect is shown in Figure 2.

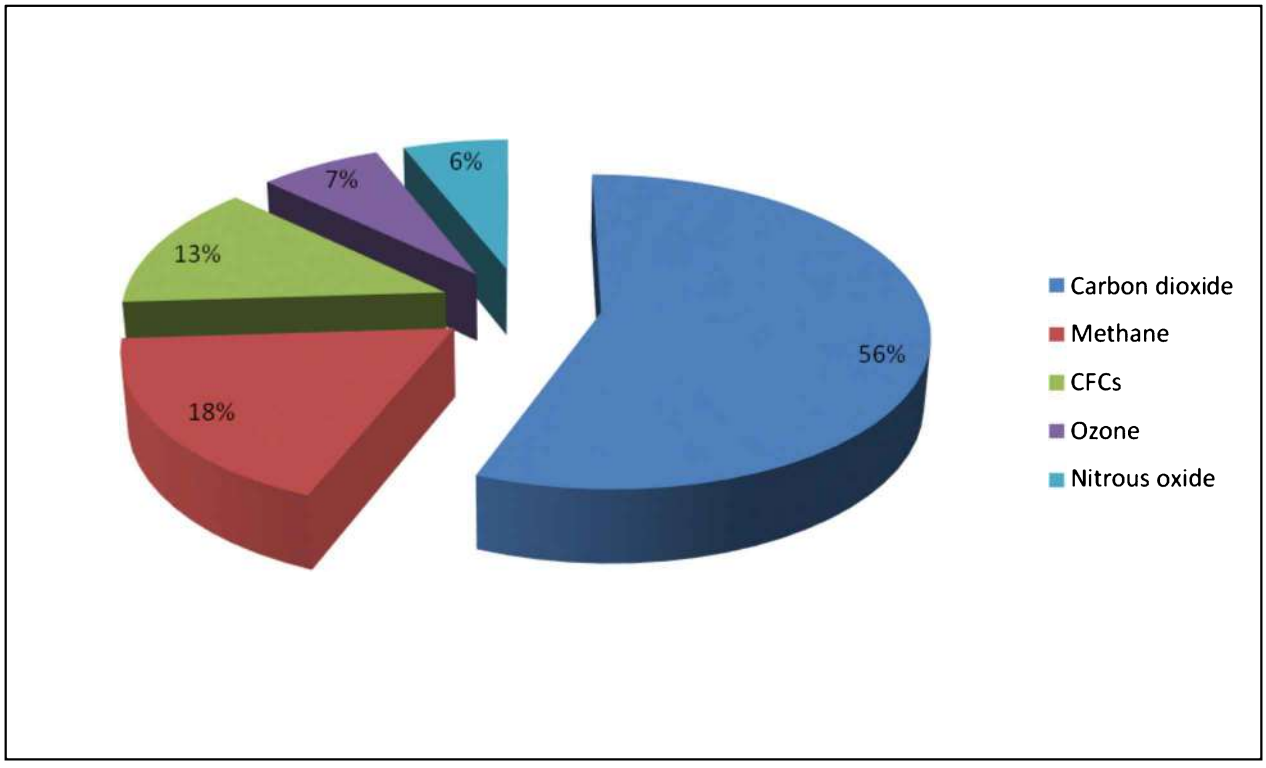


Figure 2: Contribution of various gases to the anthropogenic greenhouse effect (Botkin and Keller, 2003).

Carbon dioxide

As can be seen from Figure x carbon dioxide (CO_2) has by far the largest contribution to the anthropogenic greenhouse effect. On the other hand the presence carbon dioxide in the atmosphere has (unlike carbon monoxide) any direct harmful effect on human health or on other living organisms and is therefore not considered as air pollutant. Carbon dioxide is, of course, the product of cellular respiration. However, this does not present any problem as there has been established a perfect balance in nature – carbon dioxide produced by respiration is used in the photosynthesis. The problem exists in large additional quantities of carbon dioxide which are released in the atmosphere by combustion of fossil fuels. The final product of

combustion of any carbon containing fuel is carbon dioxide. In the case of fossil fuels – coal, oil or natural gas – great quantities of carbon which have been kept underground for millions of years are released into the atmosphere every year. Autotrophic organisms (plants, algae, cyanobacteria) are not able to process these additional quantities of carbon dioxide. The situation is still aggravated because of intensive deforestation in tropic areas.

Methane

Methane (CH_4) is product of anaerobic decay of organic matter. Nevertheless methane presence in the atmosphere derives also from natural sources human activities as are livestock breeding and waste deposition significantly contribute to the methane formation

Clorofluorohydrocarbons

Chlorofluorohydrocarbons (CFC) are problematic for the environment from two points of view. As mentioned in the previous chapter they are the main destroyers of stratospheric ozone forming in this way ozone holes. Besides this CFCs show considerable contribution to the greenhouse effect (Ramanathan, 1975; Ramanathan and Feng, 2009).

Groun-level (tropospheric) ozone

Tropospheric (ground level) ozone (O_3) has been also mentioned as one of the most problematic air pollutants. On the other hand tropospheric ozone is also important greenhouse gas.

Nitrous oxide

Nitrous oxide (or dinitrogen oxide, N_2O) is the only compound of nitrogen oxide group which is not toxic. It is known as laughing gas and is widely used as mild and very safe anaesthetic in dentistry and medicine (Sedation Dentistry 4U, 2016). Contrary to nitric oxide and nitrogen dioxide which are among the common air pollutants nitrous oxide is not designated as pollutant however it shows considerable greenhouse effect. The major source of nitrous oxide emissions is agriculture (EPA 2016 b).

4. RELATION BETWEEN AIR POLLUTANTS AND GREENHOUSE GASES

As mentioned in the introduction it seems that there is often some ambiguity when discussing about air pollutants and greenhouse gases. Nevertheless both groups of substances have negative impact on the environment and both often derive from the same sources – some substances like ground level ozone even belong also to both groups – some distinction exists between them which should be taken into account. It seems that in public discussions or by example by students when dealing with environmental content both terms are often confused.

Thus fossil fuels combustion presents both one of the main sources of pollutants as are particulate matter, hydrocarbons, carbon monoxide and nitrogen oxides as well as on the other hand also the source of carbon dioxide - the most important greenhouse gas. In the case of automotive exhaust emissions of pollutants can be efficiently lowered by catalytic converters or particle filters which have no effect on carbon dioxide emissions. Emissions of carbon dioxide can be lowered only by reduced consumption of fuel or use of alternative fuels or driving modes.

Biomass and biofuels are theoretically considered as carbon neutral. By the combustion of biomass or biofuels, of course, also carbon dioxide is formed. However, this is compensated by the photosynthesis during plant growth where the same amount of carbon dioxide is used. The net quantity of the entire cycle (plant growth – fuel production – fuel use) is zero. The carbon dioxide balance comparison for fossil fuels and biomass/biofuels is shown in Figure 3.

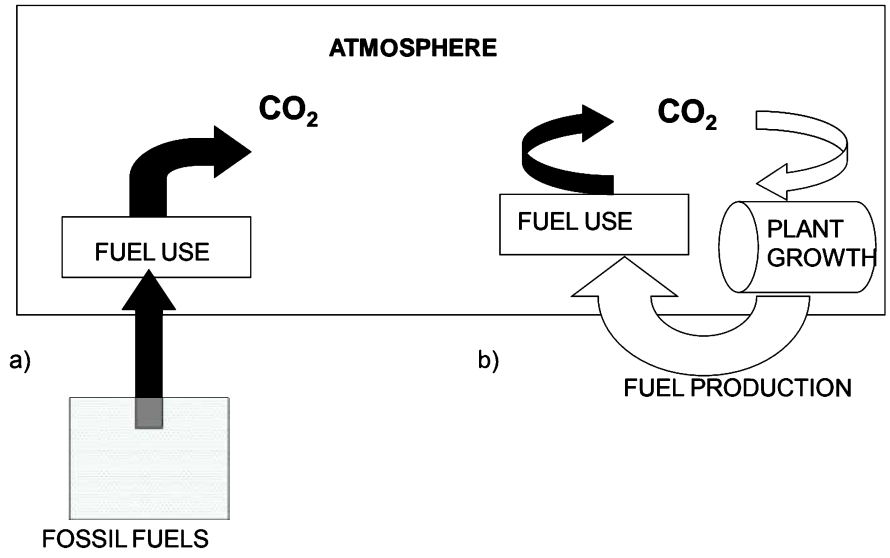


Figure 3: Balance of carbon dioxide emissions for a) fossil fuels and b) biofuels.

It should be emphasized that this is idealized picture and that in practice there are certain net emissions of carbon dioxide. Nevertheless, by the substitution of fossil fuels with fuel derived from biomass considerable lowering of greenhouse gases emission can be achieved. The actual lowering of carbon footprint depends on the source of biofuel and their mode of production. Therefore substitution of fossil fuels with fuels of biological origin is desired from the viewpoint of greenhouse effect. However, this does not necessarily mean that biofuels or biomass presents always the optimal solution when regarding pollutants emissions. In the last years, by example, in Slovenia many citizens due to increasing oil prices and insecurities in supply of natural gas have decided to change oil or gas heating for wooden pellets. Of course, their decision was motivated by economic reason. When considering environmental effects such change can be estimated as positive from the view point of greenhouse effect. However, when considering the pollutants emissions the effect is opposite as wooden biomass is problematic because of considerable emissions of particles. This can be connected with the expressed problem of elevated particle concentration in the air in urban areas in Slovenia (ARSO, 2015).

An example which also illustrates inadequate understanding of environmental topics is also by example that people still often think that lead emissions from automotive exhaust present considerable environmental problem. This really was the case in the past, however, the adding of lead to petrol in Slovenia was abandoned in 2001.

5. CONCLUSION

One of the important conditions for the comprehension of environmental problems is the ability to distinguish between different categories and terms. It seems that terms air pollutant and greenhouse gas are often confused. Nevertheless both categories are undesired from the environmental point of view and often derive from the same source and sometimes certain substance can even behave both as air pollutant and greenhouse gas these two terms should not be equated. The understanding of physical, chemical and biological processes connected with these phenomena are important for adequate understanding. Therefore it is important to devote adequate attention to this problem in environmental education programs. Rising of the level of environmental awareness is important part of environmental education and can be designated as necessary condition for improving the environment. However, adequate knowledge and comprehension of processes seems to be the sufficient condition that someone is capable of solving environmental problems.

REFERENCES

Abrams, J. (1996). Beneficial Actions of Nitrates in Cardiovascular Disease. The American Journal of Cardiology 77 (13) C31-C37.

ARSO (2015): Naše okolje – Bilten Agencije RS za okolje (in Slovene: Our Environment – Bulletin of the Environmental Agency of the Republic of Slovenia, Vol. XXII, No. 1 -12 (January-December 2015).

ARSO (2016). Onesnaževala zraka (in Slovene: Air pollutants). Environmental Agency of the Republic of Slovenia, Ministry for the Environment and Spatial Planning of the Republic of Slovenia. Retrived from http://okolje.arso.gov.si/onesnazevanje_zraka/vsebine/onesnazevala-zraka on April, 14, 2016.

Botkin, B.B. & Keller, E.A. (2003). Environmental Science: Earth as a living planet. New York, John Wiley & Sons Inc.

CDC (2011): Centers for Disease Control and Prevention – NIOSH Pocket Guide to Chemical Hazards: Nitric oxide Retrived from http://www.cdc.gov/niosh/npg/npgd0448.html on April 17, 2016.

Dieselnet (2015). Dieselnet – Emissions – Europe Union – Cars and Light Trucks. Retrieved from https://www.dieselnet.com/standards/eu/ld.php on April 17, 2016.

Dorevitch, S, Karandikar, A., Washington, G.F., Walton, G.P., Anderson, R. & Nickels, L (2008). Efficacy of an outdoor air pollution education program in a community at risk for asthma morbidity. Journal of Asthma, 45(9), 839-844. doi: 10.1080/02770900802339759.

EPA (2016 a). Criteria Air Pollutants. EPA – United States Environmental Protection Agency. Retrieved from https://www.epa.gov/criteria-air-pollutants

EPA (2016 b). Nitrous Oxide Emissions – Owerview of Greenhouse Gases. Retrieved from https://www3.epa.gov/climatechange/ghgemissions/gases/n2o.html

Goudarzi, G., Geravandi, S., Foruozandeh, H., Babaei, A.A., Alavi, N., Niri, M.V., Khodayar, M.J., Salmanzadeh, S., & Mohammadi, M.J. (2015). Cardiovascular and respiratory mortality attributed to ground-level ozone in Ahvaz, Iran. Environmental Monitoring and Assesment, 187(8), 487. doi: 10.1007/s10661-015-4674-4

Lazarini, F., & Brenčič, J. (1984). Splošna in anorganska kemija (in Slovene: General and inorganic chemistry). Ljubljana: DZS.

Mondt, J.R. (2000). Cleaner Cars: The History and Technology of Emission Controle since 1960s, Warrendale Pa., Society of Automotive Engineers Inc.

Oxtoby, D.W., Gillis, H.P., & Nachtrieb, N.H. (1999). Principles of modern chemistry, 4th edition. Forth Worth etc.: Saunderse College Publishing.

Petrović, N. (2009). Ekološki management (in Serbian: Ecological Management). Beograd. Fakultet organizacionih nauka.

Proietti, C., Anav, A., De Marco, A., Sicard, P. & Vitale, M. (2016). A multi-sites analysis on the ozone effects on Gross Primary Production of European forests. Science of the Total Environment, 556, 1-11. doi: 10.1016/j.scitotenv.2016.02.187.

Ramanathan, V (1975). Greenhouse Effect Due to Chlorofluorocarbons: Climatic Implications". Science, New Series 190 (4209):50–52. doi:10.1126/science.190.4209.50. JSTOR 1740877

Ramanathan, V; Y. Feng (2009). "Air pollution, greenhouse gases and climate change: Global and regional perspectives". Atmospheric Environment 43: 37–50. doi:10.1016/j.atmosenv.2008.09.063

Sedation Dentistry 4U (2016). History of Nitrous Oxide Sedation Dentistry. Retrieved from 2016 http://www.sedationdentistry4u.com/nitrous-oxide-sedation-history.htm on Aprile 24, 2016

Simoni, M., Baldacci, S., Maio, S., Cerrai, S., Sarno, G. & Viegi, G (2015). Adverse effects of outdoor pollution in the elderly. Journal Thoracic Disease, 7(1), 34-45. doi: 10.3978/j.issn.2072-1439.2014.12.10

UNECE (2016). The 1979 Geneva convention on trans-boundary air pollution. Retrieved from http://www.unece.org/env/lrtap/lrtap_h1.html on April, 14, 2016.

WHO (2003). Health Aspects of Air Pollution with Particulate Matter, Ozone and Nitrogen dioxide. Retrieved from http://www.euro.who.int/__data/assets/pdf_file/0005/112199/E79097.pdf on April 17, 2016.

WHO (2013). Health Effects of Particulate matter – Policy implications for countries in eastern Europe, Caucasus and central Asia. Retrieved from http://www.euro.who.int/__data/assets/pdf_file/0006/189051/Health-effects-of-particulate-matter-final-Eng.pdf on April 17, 2016.

APPLICATION OF EU LEGISLATION AIMED AT PREVENTING MAJOR ACCIDENTS IN THE CONTEXT OF ENVIRONMENTAL PROTECTION

Mirjana Kovačić[1], Astrid Zekić[1], Dundović Čedomir[1]
[1]University of Rijeka, Faculty of Maritime Studies, Croatia
mirjana051@gmail.com

Abstract:
Industrial plants are major pollutants of the environment. In order to prevent and control environmental pollution and reduce the consequences in the event of major accidents, mandatory environmental requirements have been prescribed for operators who handle hazardous substances. On accessing the EU, Croatia implemented obligations in the field of environmental protection in its legislation.
The authors examine the negative phenomena that accompany the technology of industrial plants and the measures that need to be implemented in a timely manner in order to minimize damage, but also preserve the health and lives of people and property. They analyse the content of the Safety Report and the Accident and Disaster Risk Assessment of the environment, documents which have to be prepared by each operator handling hazardous substances in their facility. The aim of the paper is to point to the importance of implementation of the legal obligation to prepare documents and apply them in industrial plants.

Keywords*: industrial plant, operator, major accidents, hazardous substances, environmental pollution*

1. INTRODUCTION

People, material and cultural goods can be exposed to different types of threats, classified by their sources into two groups:

- Natural (floods, earthquakes, other natural causes)
- Technical and technological hazards (accidents in industrial facilities, traffic, nuclear threats, epidemiological accident).

This paper investigates the technical and technological hazards caused by accidents in industrial facilities which in their work handle - produce, process or otherwise use, store or dispose of hazardous substances. The degree of risk of technical and technological accidents growing into a major disaster or catastrophe depends on the type, concentration and amount of hazardous substances used by an operator at the plant, its geophysical position, the distance from the nearest inhabited place, and the speed of reaction of rescue forces. According to the pace of the action it can be immediate (e.g. explosions), very fast (e.g. sudden release/discharge of large quantities of hazardous substances) of the ongoing gradual (e.g. the spread of dangerous substances in the air or water) or a long-term view of the ongoing and acting accident (Kulišić, 2010).
An accident in the technological plant can arise due to leakage and/or explosion of dangerous substances due to the use of faulty equipment, negligent operation or deliberate sabotage. Implementation of preventive measures to avoid accidents, restricted access to parts of the plant with hazardous substances only to authorized personnel, and responsible behaviour towards the environment demonstrated in informing the local population of the potential hazards, application of measures taken to prevent accidents and methods of self-defence until the arrival of protection and rescue forces in the event of an accident, are the obligation of all technological facilities.
The consequences and impact of such disasters on the environment can vary. Through their destructive effects on both the environment and the economy or safety of life, they affect the economic and social development of the regions exposed (Babut et al, 2015). Investments in safety are related not only to reduce financial losses, caused by industrial accidents, but they also represent an opportunity for sustainable business development and competitiveness leading to industrial growth (Kirin et al, 2012).

2. IMPLEMENTATION OF THE SEVESO DIRECTIVE INTO THE CROATIAN LEGAL SYSTEM

The incident that occurred in 1976 in Seveso, Italy from the ICMESA chemical plant for the production of herbicides and pesticides prompted the EU to regulate yet another segment of environmental protection, the one referring to the prevention and control of industrial pollution and risk management. Since then, numerous activities have been undertaken and many regulations and documents adopted in order to prevent and reduce the environmental impact of industrial plants. Protection of the environment consists in determining the thresholds for different forms of pollution, proposing legislation, and introducing preventive

and corrective measures in the event of non-compliance or any incident in the environment (Kondić & Piškor, 2010).
The Seveso Directive aims at the prevention of major accidents involving dangerous substances and their mixtures, but also at limiting the consequences of such accidents not only for human health but also for the environment and thus ensure a high level of protection across the EU in a consistent and effective way. The Directive defines certain special obligations of each legal entity/operator/company, namely, the operator, in taking measures to prevent major accidents, their obligations in the event of significant changes in the installation of the legal person/operator/company, obligations in the event of a major accident, procedures and obligations in the event of a major accident with cross-border effects, the obligation to reduce the consequences of a major accident, as well as other conditions and measures to prevent major accidents in accordance with internationally recognized standards and regulations; and the manner of submitting reports on the implementation of security measures and their mandatory content (Soflić, 2013).
At present, EU member states regulate accidents in industrial facilities handling hazardous substances according to the provisions of the Seveso III Directive. Substances and mixtures in the scope of the Seveso Directive are assigned to a generic entry based on hazard classification, or to a specific named entry when one is available (Petrus et al, 2013). Compared to the Seveso I and II (Directive 96/82 / EC), the Seveso III Directive (Directive 2012/18/EU) provides better access to information on the risks arising from the activities of industrial facilities that handle dangerous substances.
Upon its accession to the European Union, the Republic of Croatia fulfilled its obligations in the field of environmental protection and aligned its environmental policies with EU laws. Croatia aligned its legislation in the field of air, climate change, water, waste management, water and coastal areas, nature protection, industrial pollution and risk management, soil and land, chemicals and noise (Nekić & Krajnović, 2015).
The objectives of Council Directive 96/82/EC, Directive 2003/105/EC and Council Directive 2012/18/EU of the so-called Seveso II Directive, namely, the establishment of a safety management system and the shift from remedial to preventive action, were transposed into the Croatian legal system through the Regulation on the prevention of major accidents involving dangerous substances (Official Gazette 44/14). The Regulation stipulates the obligations of the operator for preventing major accidents by implementing a series of precautionary measures in accordance with the extent of the potential dangers recorded in the relevant facility.
The valid EU regulations were transposed into national legislation in 2008 with the Regulation on the prevention of major accidents involving dangerous substances, the Ordinance on the registry of installations in which dangerous substances are present and the Register of reported major accidents, the Law on Protection and Rescue, and the Regulation on the methodology for making risk assessment and protection and rescue plans. The Regulation on the prevention of major accidents involving dangerous substances prescribes the types of hazardous substances and groups of hazardous substances that are present in plants, their respective amounts and the criteria by which these substances are classified as dangerous. It also prescribes the special obligations of the operator and the plant in taking measures to prevent major accidents, the obligations in the event of a major accident, the procedure and obligations in the event of a major accident with cross-border effects, the obligation to reduce the consequences of a major accident, as well as other conditions and measures to prevent major accidents in accordance with internationally recognized standards and regulations.
The Seveso Directive obliges EU Member States to make sure that their operators who handle hazardous substances above the minimum amount implement the Policy of prevention of major accidents in their work. The policy of preventing major accidents established by the operator must be designed so as to guarantee a high level of protection of people and the environment by appropriate means, structures and management systems, all in accordance with the Regulation on the prevention of major accidents involving dangerous substances (Official Gazette 44/14).
The implementation of the Policy of prevention of major accidents is monitored through an internal control in the field of sustainable development, protection of health, safety and the environment, internal and external audits of the quality system, through a system of internal audits and through inspections. The consequences of non-compliance with the Policy are subject to penalty provisions. The Policy can be updated or revised when it needs to be harmonised with the new legislation, or when some irregularities have been detected during internal controls, audits or inspection. All employees are to be informed about the possible steps and trained for the proper procedures in their area of competence stipulated in internal documents. During regular activities of a facility, external contractors also have to receive proper training before they start working in it. The training should cover all the information about the risks, obligations and responsibilities of the contractor, and also an introduction to the Policy.
Safety reports and internal emergency plans are drafted and publicly presented for all facilities in which major accidents may occur. A safety report describes all the measures to be taken in order to prevent major accidents, as well as the structure of the safety management system.
Control is carried out thought a structural approach, which implies that the higher the presence of hazardous substances in a facility, the more stringent are the rules applying to it. Facilities with an elevated presence of hazardous substances area classified as upper tier, and those with a lower level as lower tier facilities.

The Environmental Protection Act (Official Gazette 80/13, 153/13, 78/15) defines hazardous substance as substances, mixtures or preparations present in a plant as raw materials, products, by-products, rest or semi-products, including the substances which may be expected to be created in the event of an accident and which may have harmful consequences for human health, property and the environment. The use of hazardous substances is indeed inevitable in industry, but their effect on human health and the environment can be disastrous. The direct impact of hazardous substances is reflected in the functional changes of the matter in which they act. Indirect effects of hazardous substances are most commonly manifested as fires, consequences of explosions and radiation of radioactive substances, due to the fact that some of them react with oxygen (fuel as flammable liquids, gases and solids, oxidizers, ignition devices, corrosive substances), quickly decompose chemically (explosives, explosive-filled objects), or react with substances with which they come into contact, e.g. with water or other substances (Pavelić, 2013).
The Regulation on the prevention of major accidents involving dangerous substances (Official Gazette 44/14) stipulates the method of determining the quantities, the permitted quantities and the criteria according to which these substances are classified as dangerous; the method of submitting and mandatory content of the notification of the presence of hazardous substances in a plant; the mandatory content of the Statement of conduct with regard to the prevention of major accidents; the mandatory content of the Safety report, the manner of application for approval of the Safety report; the mandatory content and manner of giving approval; the manner of application for extension of approval issued and the relevant deadlines; data confidentiality agreement; the manner and conditions of supervision of the implementation of activities and measures in accordance with the issued approval of the Safety report; special obligations of the operator in: taking measures to prevent major accidents, in the event of significant changes in the plant, in the event of a major accident, the procedure and obligations in the event of a major accident with cross-border effects, other conditions and measures to prevent major accidents in accordance with internationally recognized standards and regulations, the content and manner of keeping records of operators and their plants in which accidents with a domino effect may occur, and other relevant issues. The Annexes of the Regulation comprise:

- List of hazardous substances and the threshold quantities above which the substances are considered dangerous (Annex I.A)
- List of hazardous substances and the threshold quantities above which the substances are considered dangerous (Annex I.B.)
- Forms to be used to report on the presence of hazardous substances (Annex II).
- The form to be used to report on the presence of hazardous substances in the area of a plant with quantities below the threshold quantities under Annex I.A or Annex I.B of the Regulation (Annex II.A)

The Regulation applies to the areas of plants in which dangerous substances were identified in quantities equal to or greater than those listed in Annex I.A, parts 1 and 2, and in Annex I.B. of the Regulation.

3. SAFETY REPORT

The purpose of the Safety report is for the operator to demonstrate that they have taken all the technical, organizational and management measures to prevent major accidents and that all the possible risks of a major accident have been analysed. It is the operator's task to enable the competent authorities to evaluate the safety of a plant in terms of the possibility of major accidents occurring in it.
A safety report typically contains information on the management and organizational of the plant from the aspect of preventing major accidents, and refers to the policy of preventing major accidents and safety management system, which includes the organization and personnel, identification and assessment of significant risks, supervision of the plant operations, change management, planning for emergency, monitoring effectiveness, audit and inspection.
Description of the location of the plant area includes, in addition to its description, the identification, definition and analysis of adjacent facilities and areas, including public facilities such as hospitals or schools that could be the source of or increase the risk of accidents and their consequences through the domino effect. Preventive measures are implemented through permanent control of security systems, equipment maintenance and supervision of working procedures.
The operator must evaluate the possible consequences of a major accident for both human health and the environment, and calculate the size of the impact area according to the "worst case scenario". When formulating a scenario, the probability of natural disasters occurring within the area of the plant are taken into account and used as a starting point for predicting the measures, procedures and technologies that would be able to reduce the risks to a minimum considered (Plavšić, 2006). Description of all unwanted scenarios that could lead to a major accident in an industrial plant, the probability of their occurrence and the estimated effects require an accurate presentation of the results, including the "worst case scenario". Based on the results of such analyses, preventive, accidental and palliative procedures for reducing the effects on the area

affected by a major accident are defined (Toth et al, 2010). The operator must secure the safety feasibility report at all times (Buljan & Mikulić, 2010).
An integral part of the Safety report is the internal emergency plan, which must contain all the data and information contained in Annex V of the Regulation and the provisions governing protection and rescue. The internal emergency plan can be used for preparation of the external protection and rescue plans for operational and rescue forces in the event of accidents involving hazardous substances or those of natural and technical-technological causes that can result in disasters or major accidents, including the ravages of war and the consequences of terrorism. The preparation of external emergency plans is the obligation of the counties and the City of Zagreb pursuant to a decision of the Director of the State Administration for Protection and Rescue. After completion of a draft external emergency plan, its parts that are not confidential should be presented to the public, and interested and professional public invited to give their opinions, suggestions and comments. Public participation can also use the private sector so as to help it discover inefficiencies in the production process of raw materials, energy consumption, which can lead to an actual reduction in production costs (Ofak, 2009).

4. RISK ASSESSMENT OF THE POPULATION, MATERIAL AND CULTURAL GOODS AND THE ENVIRONMENT FROM DISASTERS AND MAJOR ACCIDENTS

Risk assessment of the population, material and cultural goods and the environment from disasters and major accidents is the baseline document for the development of plans, operational plans and civil protection plans. It is prepared and adopted for the territory of municipalities, cities, counties, the City of Zagreb and the Republic of Croatia. Such assessment also has to be made by all legal persons handling hazardous substances. The assessment includes the potential threat to the population, material and cultural goods and the environment from the occurrence and impact of disasters and major accidents, the necessary funds for protection and rescue, and the preparedness to act in the protection and rescue.
Due to the variety of accidents on the one hand, and their consequences on the other, analysis of the threat of natural and other disasters must consider several related aspects associated with the natural, civilisational and other phenomena that exist in the monitored area. It evaluates the likely intensity of these phenomena, the possible surprise effect, namely, the speed with which a given phenomenon may occur and develop, the degree of threat to people and property, the overall level of social organization, and the preparedness for prevention, protection and rescue, especially for those in charge of activities and tasks in the field of protection and rescue. Furthermore, account should be taken of the number of local population in a given time period that may be at risk, especially during the tourist season.
Hazard analysis includes methods of determining the sensitivity of a geographical area with regard to the discharge of hazardous substances, identification of potential sources of emissions of hazardous substances from stationary facilities that manufacture, process or otherwise use, store or otherwise dispose of substances that are generally considered dangerous. Using software and mathematical calculations and a series of elaborations by each individual case of threat, it is possible to calculate the degree of risk for the areas for which the assessment is being made.
The content of the assessment is determined by the Regulations on the methodology of development of threat assessment and protection and rescue plans (Official Gazette 38/08). The assessment includes:

1. the type, intensity and effects, and possible consequences of natural and technical-technological disasters and major accidents for the population, material and cultural goods and the environment
2. protection and rescue forces,
3. final assessment,
4. maps.

Local and regional governments define and prescribe preventive measures the implementation of which will reduce the consequences and effects of the natural and technological disasters and major accidents, and increase the level of safety of the population, material goods and the environment in the special excerpt from the Assessment, entitled Requirements for protection and rescue in physical planning documents.

5. ANALYSIS OF THE SITUATION IN THE REPUBLIC OF CROATIA

The Environmental Protection Act (Official Gazette 80/13, 153/13, 78/15) stipulates the introduction of implementing legislation governing the prevention of major accidents involving hazardous substances, and the adoption of the Ordinance which prescribes the manner of organization and content and method of keeping the Register of facilities in which dangerous substances are present and the Register of reported major accidents. The presence of hazardous substances in small quantities requires procedures in accordance with regulations governing protection and rescue, and the data submitted to the Environmental Protection Agency and the State Administration for Protection and Rescue.

The list of plant areas in Croatia in which dangerous substances of the lower and higher tier are present ("Seveso-bound") and those bound by Annex II.A is shown in Table 1.

Table 1: Facilities in which dangerous substances were present on 19/01/2016

Counties and the City of Zagreb	Facility area category - upper tier	Facility area category – lower tier	Facility rank – lesser amount	Facilities bound by Annex II.A	Facilities currently applying
Zagreb	3	3	0	27	21
Krapina-Zagorje	2	1	0	21	5
Sisak-Moslavina	5	5	0	3	26
Karlovac	1	4	0	9	18
Varaždin	0	2	0	21	2
Koprivnica-Križevci	1	0	0	14	1
Bjelovar-Bilogora	1	0	0	15	2
Primorje-Gorski Kotar	4	0	0	46	2
Lika-Senj	0	1	0	18	1
Virovitica-Podravina	0	1	0	8	2
Požega-Slavonia	0	0	0	12	3
Brod-Posavina	1	0	0	14	7
Zadar	0	0	1	25	5
Osijek-Baranja	1	4	0	35	1
Šibenik-Knin	0	0	3	13	4
Vukovar-Srijem	0	0	0	24	2
Split-Dalmatia	2	4	0	39	7
Istria	1	3	0	53	40
Dubrovnik-Neretva	1	0	0	19	2
Međimurje	0	1	0	17	1
City of Zagreb	3	4	0	58	9
Total	26	33	4	491	161

Source: authors according to the Register of installations in which dangerous substances are present

A total of 63 areas of the facilities bound by requirements of the Seveso Directive were found, of which 26 of the upper tier, 33 of the lower tier, and four areas with lesser amounts. There were 491 areas of facilities with quantities below the threshold values given in Annex IA that are bound by Annex IIA of the Regulation, and 161 business entities that are in the process of application in accordance with Annex IIA.

6. CONCLUSION

All business entities that use hazardous substances in their daily operation are exposed to the potential risk of accidents caused by fire, explosion or release of hazardous materials. In order to reduce such risks, a number of organizational and technical measures are applied.

It is the obligation of the operator to produce a safety report to demonstrate that appropriate measures will be taken for the identified risks of major accidents in the plant in order to prevent such accidents and limit their consequences. General and interested public must be informed about the possibility of a major accident occurring and its potential consequences. An appropriately drafted internal emergency plan can be used for preparing an external emergency plan.

Assessment of the level of risk of disasters and major accidents to which the population, material and cultural goods and the environment are exposed is used to define the threat and risks that could endanger local communities. The needs and possibilities of prevention, reduction and elimination of consequences of disasters and major accidents are also assessed.

Precautionary measures are taken, as far as possible, at the very source, i.e., in the facility, in order to minimize the possibility of a major accident. Timely preparation of an accident scenario and the acquired knowledge and skills can help prevent accidents and mitigate their consequences.

REFERENCES

Babut, G.B., Moraru, R. I., Dura, C. (2015). Conceptual and Methodological Framework for Risk Analysis and Evaluation on Seveso Industrial Sites (I) Risk Evaluation Terminology, Objectives and Stages, *Quality - access to success*, Vol.16, pp 111-116.

Buljan, H., Mikulić, N. (2010). Sprečavanje velikih nesreća koje uključuju opasne tvari prema Seveso II direktivi u R Hrvatskoj, *Hrvatska platforma za smanjenje rizika od katastrofa,* Zagreb, pp. 141-146.

Kirin, S., Sedmak, A., Mitrović, R., Stanojević, P., Ilić, Đ. (2012). Safera – Evropski projekt industrijske bezbednosti, *Integritet i vek konstrukcija*, Vol. 12, br. 3, pp. 181-184.

Kondić, V., Piškor M. (2010). Sustav upravljanja zaštitom okoliša prema normi ISO 14001 i razvoj metodologije za njenu implementaciju, *Tehnički glasnik*, Vol.4, pp. 111-118.

Kulišić, D. (2010). O smanjenju rizika od katastrofa u industriji i transportu opasnih tvari, *Zbornik radova, Hrvatska platforma za smanjenje rizika od katastrofa,* Zagreb, pp.126- 131.

Nekić, B, Krajnović, A. (2015). Politika zaštite okoliša u RH nakon pristupanja Europskoj uniji, *Tranzicija,* Vol.16, pp. 39-58.

Ofak, L. (2009). Sudjelovanje javnosti u odlučivanju o pitanjima okoliša, *Hrvatska javna uprava*, god. 9., br. 2., pp. 443–470.

Pavelić, Đ. (2013). Mjere zaštite pri uporabi visokorizičnih opasnih tvari, *Sigurnost,* 55 (2), pp. 153 – 155.

Petrus A. M. Heezen, Gunnarsdóttir, S., Gooijer L., Mahesh, S. (2013) Hazard classification of biogas and risks of large scale biogas production, *Chem Engineer Transact*, Vol. 31, pp. 37-42.

Plavšić, F., Wolf-Čoporda, A., Lovrić, Z., Čepelak, D. (2006). Siguran rad s kemikalijama, Zagreb.

Sofilić, T. (2013). Opasne tvari u okolišu, Sveučilište u Zagrebu, Metalurški fakultet, Sisak.

Toth, I., Škanata, D. (2010). Smanjenje rizika od velikih nesreća u industrijskim postrojenjima, *Zbornik radova, Hrvatska platforma za smanjenje rizika od katastrofa*, Zagreb, pp.87- 90.

Pravilnik o metodologiji za izradu procjena ugroženosti i planova zaštite i spašavanja. Zagreb: Official Gazette 30/14, 67/14.

Uredba o sprječavanju velikih nesreća koje uključuju opasne tvari. Zagreb: Official Gazette 44/14.

Zakon o zaštiti okoliša. Zagreb: Official Gazette 80/13, 153/13, 78/15.

www.azo.hr.. Agencija za zaštitu okoliša, 16.02.2016.

COMBINING LEAN AND GREEN IN LOGISTICS: A SURVEY OF LOGISTICS COMPANIES IN SLOVENIA

Vaska Pejić*[1], Andrej Lisec[1]
[1]Faculty of Logistics, University of Maribor
*Corresponding author, e-mail: vaska.pejic@um.si

Abstract:*Lean and green management practices represent a major opportunity for Slovenian logistics companies to competently respond to the escalating expectation of a global logistics market and achieving environmental performance profitably. In this paper, a survey analysis on lean logistics and green logistics among Slovenian logistics companies will be presented. Although similar analysis on lean and green do exist, only a few of them focus on the field of logistics as such and also none of them have been performed in Slovenia. Key findings indicate that the surveyed Slovenian logistics companies obtain more certificates and/or recognition concerning lean than green, most of them prove their leanness and/or greennesswith ISO standards ISO 9001 and ISO 14001 and that the surveyed companies in most implement lean and green concepts within their companies.*

Keywords*:logistics, lean, green, sustainable, ISO standards*

1. INTRODUCTION

A key task of a well function logistics system is that it has to guarantee that goods are in the right place, at the right time and in the strictly necessary quantity. The latter allows us to fully comprehend its real mission, which is to better ensure the space and time availability of goods through flows management (La Londe, 1983). Its activities are often identified with a high degree of manual control and human resource management of, which in turn greatly affects the execution of operations. Especially costly time interruptions, which result out of failure in material or information flows, explain the importance of a well-functioning logistics system (Christopher, 1992).

Maintaining low costs in a bid to gain/obtain competitiveness is of substantial significance; consequently, companies are forced to examine every part of their organization for potential improvements. It is therefore not surprising that there are many initiatives for possible improvements in logistics. We also have to acknowledge that global logistics costs were estimated at USD 9,177 billion in 2015 (Armstrong & Associates, 2014), so every failure, inconsistency or any kind of waste can represents great costs.

Besides eliminating non-value added activities in logistics, also assuring sustainable processes is one of modern companies‟ challenges. The environmental aspect and ecological consciousness have increased drastically over the last two to three decades, especially in the developed economies. This has been shown by BearingPoint research (*Supply Chain Monitor "How Mature is the Green Supply Chain?"* 2008), where 35% of global companies said that they have incorporated a green supply chain policy in the company‟s vision.

The area of logistics has been rarely exposed to research on lean and green, most of them were in fact made in other fields, mainly in the area of lean manufacturing management. Therefore, this study represents a contribution for academia and industry. For academia mainly due to the fact that this research is one of the first of its kind and it takes into account both paradigms in the area of logistics. For industrials it will provide an insight on the current state of lean and green logistics implementation in Slovenia‟s logistics companies, new trends and possible contributions from each paradigm.

The most important aim of this survey, of which this paper presents some results, is to analyse the respondent‟s familiarity with the terms „lean logistics‟ and „green logistics‟, their opinion on the implementation of both concepts within their own companies. Furthermore, the attempt has been made to highlight which certificates or recognition from both areas Slovenia‟s logistics companies hold.

2. METHODOLOGY

First of all an extensive analysis of previous research has been conducted. The search has been restricted to articles which contained specific keywords connected to lean logistics and green logistics in Emerald Online, Science Direct, Springer Link and Taylor and Francis portals. For keywords we firstly employed a brainstorming technique and then decided to narrow our choices and only focus on international journal articles which contained specific keywords closely associated to lean logistics and green logistics. At the same time keywords containing „supply chain", „production" or „manufacturing" were mainly excluded. The main reason lies in the fact that the aim was to narrow the scope of the research to a specific field – logistics rather than supply chain management or production and manufacturing.

It was further noted that some of the international journals have very little published articles, limited access to some of them, as well as the lack of a narrow focus on any part of lean logistics, green logistics and/or green and lean logistics.

Later on we prepared a research questionnaire and obtained 104 completed questionnaires.Our relatively small sample size required special attention to formulate appropriate conclusions, which is why we combined the statistical analysis with the abductive approach (Kovács & Spens, 2005) (see Figure 1).

The analysis was conducted through 4 phases: (1) theoretical overview where conceptual and descriptive methods were used, (2) the empirical phase features an empirical methodology which employs quantitative approaches to collecting primary data for our database and a statistical analysis.

Our survey was divided into two parts, where the first set consisted of 7 questions related to demographic issues. Second part consisted of 7 questions which were divided by individual areas of intralogistics, for which it was necessary to evaluate two aspects: lean logistics and green logistics aspect.

This means that individual company evaluated the importance of every part of intralogistics area. For the purpose of this paper we only focused on the first part, which also contained two questions regarding the familiarity with both of terms, their implementation in companies and also certificate or recognition connected to lean or green which companies could hold. (3) Theory matching between theory findings and statistical analysis findings; and at last (4) theoretical conclusions and application.

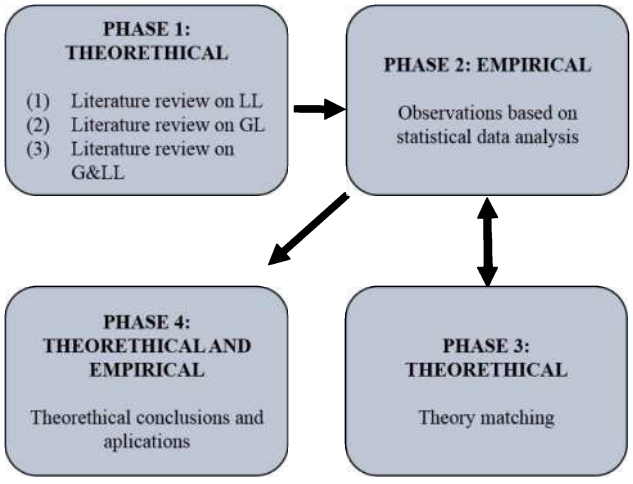


Figure 1: Abductive reasoning process

3. LEAN AND GREEN PARADIGMS IN LOGISTICS

Taiichi Ohno who was one of beginners of lean thinking and also worked in the Toyota Production System in the 80"s identified seven wastes, activities which add cost but no value: (1) production of goods not yet ordered, (2) waiting, (3) rectification of mistakes, (4) excess processing, (5) excess movement, (6) excess transport and (7) excess stock (Monden, 1993).

Since there are not only manufacturing or production created activities which add no value, industrials also started to put their focus on logistics non-value-added activities. From here on the new concept – lean logistics – appeared. By Baudin (2004), lean logistics is a logistical dimension of lean manufacturing. Its primary objective is to deliver the right materials to the right locations, in the right quantities, and in the right presentation; its second to do all this efficiently.

During 1990"s another practice of responding to environmental issues in a socially responsible manner – environmentalism has become increasingly important. It has been characterized as one of the most significant force shaping the economy (Limoubpratum, Shee, & Ahsan 2014; Murphy, Poist, & Braunschweig, 1995). Many articles based on concern for the environment have at that time also been written in the field of business and logistics (Van Hoek, 1999; Wu & Dunn, 1995).

The fundamentals of greening as a competitive initiative have also been discussed by Porter & van der Linde (1995). Their basic reasoning was that investments in greening can be resource saving, waste eliminating and productivity improving. They state that green initiatives could lower not only the environmental impact of a business but also raise efficiency, possibly creating major competitive advantages in innovation and operations. Skjoett-Larsen (2000) wrote a foresight work upon European companies facing new challenges in the next millennium one of which is also green logistics. The author stipulates that within the next five to ten years green supply chains will increasingly dominate the theory and practice in the logistics area. Moreover, with green logistics a completely new sub-sector of logistics appeared, using new models and tools as green logistics management. The trend is therefore to switch from traditional logistics to green logistics (Beškovnik & Twrdy, 2015).

There are separate streams of research on lean logistics and green logistics, however few researchers explore some intersections of these two paradigms (Banawi & Bilec, 2014; Garza-Reyes, 2015). This represents a critical point for companies which are most likely missing opportunities for synergies that are available with improved simultaneous introduction and also may fail in addressing important trade-offs that may occur when there is incompatibilities between strategic initiatives.

Lean, according to (2006) is based on the assumption that time contractions reveal hidden quality problems and their solutions lead to improved, cost-effective business processes. The authors further contend that if time contraction implies to lower emissions, then as by the emissions measurements, a lean system is always greener. If the reduction of time does not lead to reduced emissions, it is necessary to find a way or further changes of the lean system to become greener.

Researchers state that lean companies, which include green practices, achieve better lean results than companies which do not. Their findings indicate that only when both concepts are implemented simultaneously, they can disclose their full potential and make a greater contribution than if they were implemented separately. As such (Bergmiller & McCright, 2009), emphasize that while lean practices can lead to positive environmental contributions, conversely environmental practices often lead to improved lean practices.

Nevertheless, a waste of both paradigms is defined otherwise but both respectively target the removal of excess: the waste in the broadest sense. Lean logistics is focusing on removing 8 wastes related to efficient flow, while green logistics is focusing on green wastes in the form of inefficient use or waste production (Kleindorfer, Singhal, & Van Wassenhove, 2005).

4. ANALYSIS AND RESULTS

The following sub-sections present and discuss our results.

Analysis of demographic data referring to data on the respondents and companies in which respondents are employed. The data are presented in the following tables.

Table 1: Demographic data related to companies, in which respondents are employed

Variables	Replies	Percent (%)
D1 Company activity		
Service	81	38.21
Manufacturing	97	45.75
Trade	34	16.04
D2 Company size		
a) Up to 10 employees (micro enterprise)	76	35.85
b) Small (11-50 employees)	63	29.72
c) Medium (51-250 employees)	37	17.45
d) Large (more than 251 employees)	36	16.98
D3 Company as part of an international corporation		
a) Yes	41	19.43
b) No	170	80.57

A detailed examination shows that on the question »what is the main activity of the company according to the standard classification of activities« answered 212 respondents. The results show that most respondents come from manufacturing activities (45.75%), services (38.21%) and least from trade (16.04%).

Concerning question about company size reveals that most of the respondents come from micro enterprises (35.85%) and least from the category of large companies (16.98%). 80.57% of companies, participating in our survey state they are not part of an international corporation.

The following demographic data refers to data concerning our respondents (see Table 2).

Table 2: Demographic data related to the respondents

Variables	Replies	Percent (%)
D4 Working position		
a) Senior management	70	35.90
b) Head of Logistics	40	20.51
c) Head of Purchasing	8	4.10
d) Head of Production	5	2.56
e) Head of Warehouse	5	2.56
f) Technical Assistant in logistics	13	6.67
g) Head of processes/projects, which also deals with logistics	13	6.67
h) None of these	41	21.03
D6 Gender		
a) Male	113	58.85
b) Female	79	41.15
D7 Highest level of education completed		
a) High School or less	39	20.21
b) College	50	25.91
c) High Technical School	46	23.83
d) University degree or more	58	30.05

We have included senior managers (35.90%), heads of logistics (20, 51%), heads of purchasing (4.10%), heads of production (2.56%), heads of warehouse (2.56%), technical assistants in logistics (6.67%) and heads of processes/projects, which also deal with logistics (6,67%). 21.03% of respondents carry out other work.

Respondents‟ average age is 35 years. In survey participated 113 men (58.85%) and 79 (41.15%) women.

For the question concerning “completed education” largely participated in the survey those with a university degree or more (30.05%), followed by those with completed high school (25.91%), higher professional education (23.83%) and the last, the ones with high school or less (20.21%).

The next question was connected to certificates or recognition concerning lean and green management which companies could hold. There were more than one answer possible.

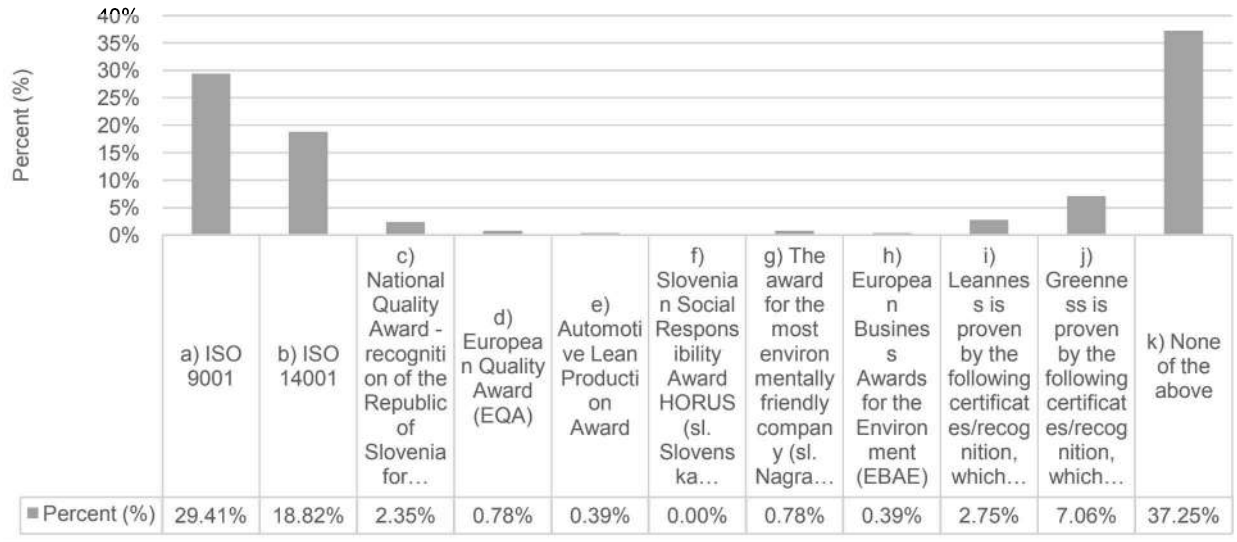


Figure 2: Data related to certificate or recognition obtained by surveyed companies

Figure 2 shows that 255 respondents answered this question of which most of the companies holds ISO 9001 (29.41%) and ISO 14001 (18.82%). 7.06% of respondents claim that they prove greenness by the following certificates/recognitions, which are not on the list and 2.75% claim that they prove leanness by the following certificates/recognitions, which are not on the list. 2.35% held the National award for quality - the recognition of the Republic of Slovenia for business excellence, 0.78% held the European Quality Award (EQA), and the prize for the most environmentally friendly company. 0, 39% of the companies held the Automotive Lean Production Award and European Business Award for the Environment (EBAE) and no one holds the Slovenian award for social responsibility HORUS.

Figure 3presents data related to the respondent"s opinion with regard to the implementation of lean and green concepts within their companies.

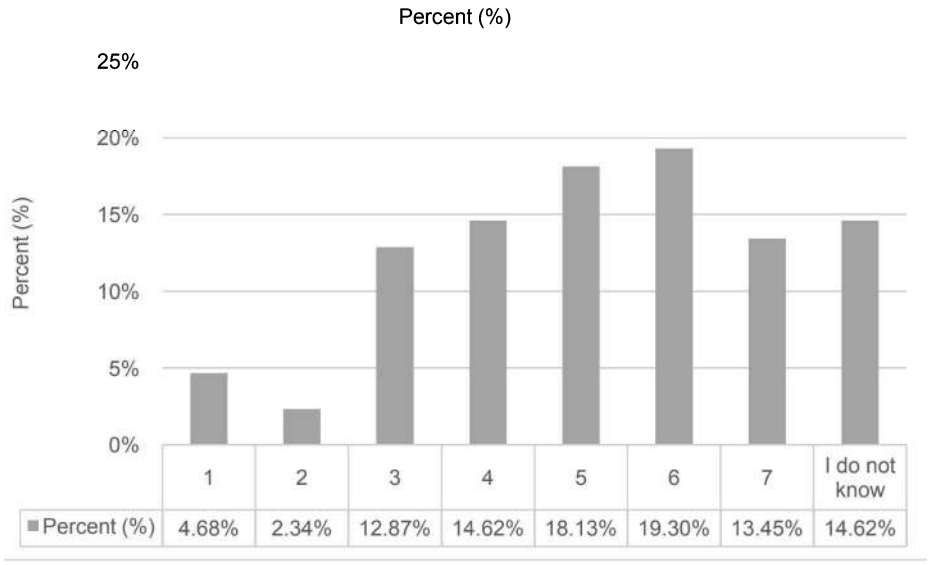


Figure 3: Data related to the respondent's opinion with regard to the implementation of a lean concept in their own company

The results show that for the opinion on the implementation of lean concept in their own company, the respondents on the 7 point Likert scale usually rated very highly, with level 6 (19.30%) and 5 (18.13%), but at least with grade 2 (2.34 %) and 1 (4.68%). The answer "I do not know" was given by 14.62% of the respondents. The arithmetic mean of the responses is 5.24.

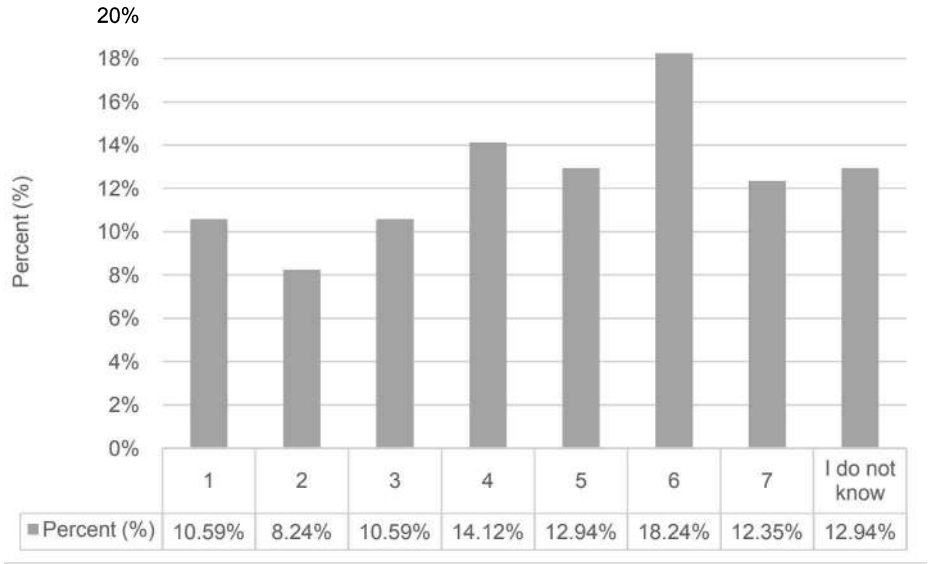


Figure 4: Data related to the respondent's opinion with regard to the implementation of a green concept in their own company

The results show that for the opinion on the implementation of green concept in their own company, the respondents rate on 7 point Likert scale usually as very high, with a rate of 6 (18.24%) and 4 (14.12%), but at least with grade 2 (8.24%), 1 and 3 (10.59%). The answer "I do not know" has given 12.94% of the respondents. The arithmetic mean of the responses is 4.79.

5. CONCLUSION

Survey findings indicate that most respondents come from manufacturing activities (45.75%) and most of the respondents from micro enterprises (35.85%). The first results are logical since the area of manufacturing is one of most developed and also largely represented Slovenia"s sectors. Also, majority of Slovenia"s companies are micro companies.

Approximately 80% of the surveyed companies are not part of an international corporation which provides an insight on a national level.

Most of our survey participants work in top management (senior managers and heads of logistics), are highly educated and are on average 35 years old. There were also almost equal parts of female and male participants participating in the survey.

In the analysis we were interested in any certificates or recognition regarding lean and green paradigms, which Slovenian logistics companies could hold. The results indicate that most of the companies hold ISO 9001 (29.41%) and ISO 14001 (18.82%) standards. Approximately 7% and 3% of respondents claim that they prove greenness/leanness by the following certificates/recognitions, which are not on the list. Approximately 2% hold the National award for quality - the recognition of the Republic of Slovenia for business excellence, less than 1% hold EQA, and the prize for the most environmentally friendly company. Only a few hold the Automotive Lean Production Award and EBAE and no one holds the Slovenian award for social responsibility HORUS.

From this on we conclude that surveyed Slovenian logistics companies obtain more certificates/recognitions concerning lean than green, also most of them prove their leanness/greenness by the mentioned ISO standards. The future research question remains which are the other certificates or recognitions with which they prove leanness/greenness within their own companies.

We were also curious about the respondents" opinion in regard to the implementation of lean and green concepts within their companies. The results show that on the opinion on the implementation of lean concept in their own company, the respondents on the 7 point Likert scale rated very highly (mean 5.24). On the implementation of green concept in their own company, the respondents also rated very highly (mean 4.79). From this we conclude that surveyed Slovenian logistics companies state that they mainly implement lean and green concepts within their companies. Our findings may be useful to suggest some missing areas or unresolved issues in our knowledge of lean logistics and green logistics. Also, in any business area, a new thought process will be embraced by many new practitioners who will put their own way of thinking on our survey results.

REFERENCES

Armstrong & Associates, I. (2014). *Global and Regional Infrastructure, Logistics Costs, and Third-Party Logistics Market Trends and Analysis*. Retrieved from http://www.3plogistics.com/Global_3PL_Market_Analysis_EIS-2014.pdf

Banawi, A., & Bilec, M. M. (2014). A framework to improve construction processes: Integrating Lean, Green and Six Sigma. *International Journal of Construction Management, 14*(1), 45-55.

Baudin, M. (2004). *Lean Logistics: The Nuts and Bolts of Delivering Materials and Goods*: Productivity Press.

Bergmiller, G. G., & McCright, P. R. (2009). *Lean Manufacturers' Transcendence to Green Manufacturing. Proceedings of the 2009 Industrial Engineering Research Conference.* Paper presented at the Industrial Engineering Research Conference.

Beškovnik, B., & Twrdy, E. (2015). Green logistics strategy for South East Europe: to improve intermodality and establish green transport corridors. *Transport, 27*(1), 25-33.

Christopher, M. (1992). *Logistics & Supply Chain Management*: Pearson Education Limited.

Garza-Reyes, J. A. (2015). Lean and green - a systematic review of the state of art literature. *Journal of Cleaner Production, 102*(2015), 18-29.

Kleindorfer, P. R., Singhal, K., & Van Wassenhove, L. N. (2005). Sustainable Operations Management (pp. 482-492): Production & Operations Management.

Kovács, G., & Spens, K. M. (2005). Abductive reasoning in logistics research. *International Journal of Physical Distribution and Logistics Management, 35*(2), 132-144.

La Londe, B. J. (1983). A reconfiguration of logistics systems in the 80s: strategies and challenges *Journal of Business Logistics, 4*(1), 11.

Limoubpratum, C., Shee, H., & Ahsan , K. (2014). Sustainable distribution through coopetition strategy. *International Journal of Logistics Research and Applications, 18*(5), 1-18.

Monden, Y. (1993). *Toyota Production System: An Integrated Approach to Just-In-Time* (2nd Edition ed.): Industrial Engineering and Management Press.

Murphy, P. R., Poist, R. F., & Braunschweig, C. D. (1995). Role and relevance of logistics to corporate environmentalism. *International Journal of Physical Distribution and Logistics, 25*(2), 5-19.

Porter, M. E., & Van der Linde, C. (1995). Green and competitive: ending the stalemate. (73), 120-134.

Skjoett-Larsen, T. (2000). European logistics beyond 2000. *International Journal of Physical Distribution & Logistics Management, 30*(5), 377-387.

Supply Chain Monitor "How Mature is the Green Supply Chain?" (2008). Retrieved from http://www.escp-eap.eu/uploads/media/Supply_Chain_Observatory_2008.pdf

Van Hoek, R. I. (1999). From reversed logistics to green supply chains. *Supply Chain Management: An International Journal, 4*(3), 129-134

Venkat, K., & Wakeland, W. (2006). Is Lean Necessarily Green? : Proc. of the 50th Annual Meeting of the International Society for the Systems Sciences.

Wu, H., & Dunn, S. C. (1995). Environmentally responsible logistics systems. *International Journal of Physical Distribution & Logistics Management, 25*(2), 20-38.

ENVIRONMENTAL MANAGEMENT AND SUSTAINABILITY: TRENDS AND PRACTICES

Tatjana Borojević[1], Marjan Senegačnik[1], Nataša Petrović*[2]
[1]University of Maribor - Faculty of Organizational Sciences, Slovenia
[2]University of Belgrade - Faculty of Organizational Sciences, Serbia
*Corresponding author, e-mail: petrovicn@fon.bg.ac.rs

Abstract: *The last few decades were marked by the growing concern for the ever growing pollution of the environment. This forced professionals in all fields - the industry, the government, institutions and the non-government sector - to put more of their attention on strategies and management which aim to reduce these negative impacts and achieve the goals of sustainable development. This reflects the key role of environmental management, for the establishment of a company-wide environmental management programs and systems contributes to a significant reduction in negative environmental impacts and the efficient use of resources and energy. To support these listed requirements of sustainable development, this paper introduces the impact of environmental management trends and practices on sustainability.*

Keywords*: environmental management, sustainability, sustainable development, environmental management trends, environmental management practices*

1. INTRODUCTION

Environmental problems have reached their critical point in the 21st century (Bonnett, 2007; Mert, 2006; Robert , Flood , & Carson , 1993) and continue to grow rapidly: global warming, worsening living conditions, disruption of the ozone layer, the impact of conservation, increase of solid waste, radioactive contamination, destruction of forests, the extinction of plant and animal species... (Petrović, 2012). In parallel, an increase in the global population has led to an increase in inefficient consumption of natural resources (Vigon et. al., 1992).

Also, in the last few decades, it has become clear that environmental issues and the questions of environmental protection shape the future, not only of the industry, but of all human activities (Petrović, 2013). The growing public environmental awareness and concern for environmental protection has led to the conclusion that the issues and environmental problems cannot be solved at the national, but instead on an international level, and that actions must be carried out that will influence the government to enact environmental laws, policies and standards (Bary, 2007; Ehrenfeld, 1994).

It's environmental management's task to achieve the necessary reduction and elimination of negative impacts on the environment wherever possible, in order to achieve the goals of sustainable development, and bearing in mind the concept of sustainable development which is based on the principle of intergenerational justice, which is defined as meeting the needs of present generations without jeopardizing the ability of future generations to also meet their needs (WCED, 1987). The role of environmental management is particularly important because it represents a broad area that is developing rapidly, and its issue affects not only all people, but all their activities because of its key role in achieving sustainable development (Barrow, 2006). Further on, economic and social demand of environmental sustainability urges companies to embrace the strategic importance of environmental management trends and practices for competitive advantage (Sroufe, 2003; Yang Lin, Chan, & Sheu, 2010).

2. SUSTAINABILITY

At the United Nations Conference on Environment and Development (UNCED) (Earth Summit, 2002) participating countries agreed to start with the development and adoption of national sustainable development strategies. The consequence of that were amendments to the definition of sustainable development – together with environmental protection, economic and social goals added, having in mind that all these three pillars are of the same importance for achieving development and sustainability on local and global level (Berg, 2009; Roseland, 2000; Roseland, 2005).

Later on, these frameworks are improved with values that refer to natural, physical, economic, human, social and cultural capital (Roseland, 2005). Also, it was concluded that young people have a crucial role in the process of democratic decision making and public participation in all activities connected with sustainable development and sustainability (UNECE, 1998; Borojevic, Petrovic, & Vuk, 2014; Borojević, Petrovic, & Vuk, 2015).

Further on, there is much discussion about how one "defines" sustainability, and related concepts (WCED, 1987; Pezzey, 1989; Costanza, 1991; Pearce & Atkinson, 1993; Costanza & Patten, 1995). Besides that, all definitions of sustainability must meet the following criteria (Sustainable Measures, 2016):

- "Living within the limits.
- Understanding the interconnections among economy, society, and environment.
- Equitable distribution of resources and opportunities."

Some definitions of sustainability are:

- Sustainability refers to "improving the quality of human life while living within the carrying capacity of supporting eco-systems." (IUCN, 1991; WWF, 1991)
- Sustainability is defined "as long-term health and vitality of a region, including the cultural, economic, environmental and social aspects as one whole." (Sustainable Seattle, 2016)
- "Sustainability calls for a decent standard of living for everyone today without compromising the needs of future generations." (UN, 2016)
- "Sustainability is based on a simple principle: Everything that we need for our survival and well-being depends, either directly or indirectly, on our natural environment. To pursue sustainability is to create and maintain the conditions under which humans and nature can exist in productive harmony to support present and future generations." (EPA, 2016)

In the context of sustainability, we should definitely mention a new sustainable development agenda for the period of 2015-2030 - Transforming our world: the 2030 Agenda for Sustainable Development as well as its The 17 Sustainable development goals (UN, 2015):

- Goal 1: End poverty in all its forms everywhere.
- Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
- Goal 3: Ensure healthy lives and promote well-being for all at all ages.
- Goal 4: Ensure inclusive and quality education for all and promote lifelong learning.
- Goal 5: Achieve gender equality and empower all women and girls.
- Goal 6: Ensure access to water and sanitation for all.
- Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all.
- Goal 8: Promote inclusive and sustainable economic growth, employment and decent work for all.
- Goal 9: Build resilient infrastructure, promote sustainable industrialization and foster innovation.
- Goal 10: Reduce inequality within and among countries.
- Goal 11: Make cities inclusive, safe, resilient and sustainable.
- Goal 12: Ensure sustainable consumption and production patterns.
- Goal 13: Take urgent action to combat climate change and its impacts.
- Goal 14: Conserve and sustainably use the oceans, seas and marine resources.
- Goal 15: Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss.
- Goal 16: Promote just, peaceful and inclusive societies.
- Goal 17: Revitalize the global partnership for sustainable development.

These objectives are the new trends of sustainability, which should affect the actions over the next 15 years in areas of critical importance for humanity and the planet.

3. ENVIRONMENTAL MANAGEMENT TRENDS AND PRACTICES FOR SUSTAINABILITY

By the late 20th century the need for structured environmental management became evident because of global pollution, loss of biodiversity, soil degradation, and urban growth. These developments are not easily tangible even though advances have been made in understanding the structure and functions of the environment, in monitoring impacts, data handling and analysis, modeling, assessment, and planning. Basically, environmental management aims to coordinate and focus such developments, to improve human wellbeing, and lessen or prevent further damage to Earth and its organisms (Barrow, 2006).

Environmental management is related to environmental planning. Further, the focus of environmental management is on: implementation, monitoring, auditing, practice and coping with real world environmental issues. Environmental management is a field of study dedicated to understanding human-environment

interactions and the applications of science in solving environmental problems and achieving sustainable development goals.

We see that environmental management is an approach to environmental stewardship which integrates ecology, policy making, planning and social development and includes: the prevention and resolution of environmental problems; establishing and nurturing institutions that effectively support environmental research, monitoring and management; warning of threats and identifying opportunities; sustaining and, if possible improving, existing resources; where possible improving "quality of life"; identifying new technology and/or policies that are useful (Barrow, 2006). So, environmental managers are those whose livelihood is primarily dependent on the application of skill in the active and self-conscious, direct or indirect, manipulation of the environment with the aim of enhancing predictability and proactive acts in a context of social and environmental issues.

There isn't just one universal definition of environmental management, because of its very broad scope and the diversity of involved specialties.

However, environmental management has following characteristics: it is generic term; it promotes sustainable development; it is a multidisciplinary and interdisciplinary approach; it integrates science, policy making and planning; it concerns ranges from local to global; it shows opportunities, threats and problems; it emphasizes stewardship, rather than exploitation.

Some definitions of environmental management are:

- Management of the environmental performance of organizations, bodies and companies (Sharratt, 1995).
- Environmental management – a generic description of a process undertaken by systems-oriented professionals with a natural science, social science, or less commonly, an engineering, law, or design background, tackling problems of the human-altered environment on an interdisciplinary basis from a quantitative and/or futuristic viewpoint (Barrow, 2006).
- A multi-layered process associated with the interaction of state and non-state environmental managers with the environment and with each other (Wilson & Bryant, 1997).

Further on, environmental management systems (EMSs) create a culture of continuous improvement, employee empowerment, waste minimization, and pollution prevention (Dües, Tan, & Lim, 2013). Also they irepresent instruments of environmental management with a high degree of formalization and unification. ISO (The International Organization for Standardization) defines environmental management system (EMS) as a management framework for reducing environmental impacts and improving organizational performance over time. The system follows a repeating cycle (Figure 1). The cycle repeats, and continuous improvement occurs.

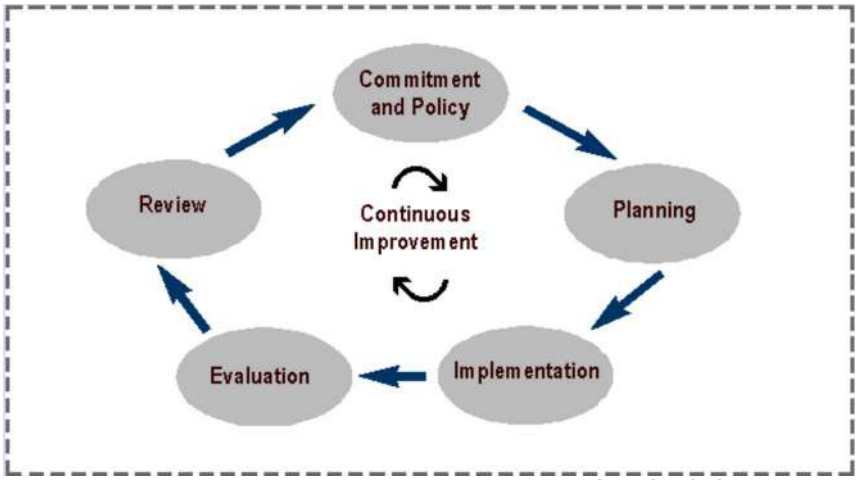


Figure 1: The continuous improvement cycle (Melnyk, Sroufe, & Calantone, 2003)

The summarized dimensions of environmental management systems are given in Table 1.

Table 1: Summarized dimensions of environmental management systems (Ross & Associates Environmental Consulting, Ltd., 2004)

Dimension	Environmental management system
Overall Type	Management system framework - Environmental management systems (EMS)
Waste Elimination Objectives	Eliminate environmental impacts and risks
Organizational Ownership/ Primary Participants	Environmental professionals, with involvement of all employees where appropriate
Drivers/Motivation	Need to better or more cost-effectively manage environmental compliance, risk, and performance, and to demonstrate this to external customers/stakeholders
Methods/Tools	Programs, processes and procedures designed by organization to support management system framework, and to meet objectives and targets
Culture Change	Employee-involved problem-solving culture; empowerment of decision-making to address needs where they occur
Improvement	Continual improvement, based on Plan-Do-Check-Act model

On the first place, the aim of environmental management is to promote sustainable development (Dorney, 1989). Also, firms which have successfully reduced their environmental impacts through implemented environmental management trends and practices also implemented practices for better sustainability of their businesses. Environmental management trends and practices have the goal of improving the organizations environmental and business performance.

Having in mind the previous studies from relevant industry, academic and non-profit entities, key environmental management trends and practices for sustainability are summarized below:

- elimination of waste and emissions,
- pollution prevention,
- maximizing energy efficiency,
- maximizing productivity,
- minimizing utilization of natural resources,
- resource management,
- investing in renewable sources of energy,
- introducing the lean manufacturing,
- introducing Kaizen approach,
- introducing green logistics,
- industrial ecology,
- cleaner production,
- sustainable production,
- clean manufacturing practices,
- energy-efficient design of equipments and products,
- water conservation,
- water management,
- reduction in the amount of packaging,
- usage of eco-friendly packaging materials,
- eco-design,
- design for environment,
- minimizing transport and travel,
- promoting environmental sustainability,
- interesting in developing eco-friendly buying behaviors,
- reducing carbon footprint,
- reusing,
- recycling,
- using more recycled materials,
- minimizing waste generation,
- waste management,
- zero waste strategy,
- environmental initiatives,
- mitigate climate changes,
- environmental reporting (voluntary as well as mandatory),
- reporting greenhouse gas emissions,
- reporting energy production,

- reporting energy consumption,
- energy management,
- usage of clean energy,
- usage of environmental performance indicators (EPI),
- building green image of company,
- environmental impact assessment,
- life-cycle analysis and life-cycle assessment (LCA),
- environmental security,
- sustainability reporting,
- adjustment with environmental regulations,
- managing corporate sustainability reputation,
- green marketing,
- sustainable marketing,
- environmental labelling,
- environmental risk management and assessment,
- increasing environmental and sustainability knowledge and understanding for all other workers,
- integrating sustainability throughout organisations and value chains.

4. CONCLUSION

During the end of the 20th century and into the 21st century environmental management emphasizes negative environmental impacts minimization and therefore have gained in popularity. Thus, trends and practices of environmental management became essential part of sustainable development as sustainable sound management that is trying to be well balanced with the Earth's capacity. Also, environmental management enhances environmental efficiency of the organization and the effectiveness of the organization's business which is also reflected in the area of cost reduction.

Several papers and researches summarized how an implementation of environmental management trends and practices show significant environmental improvements by more resource and energy efficiency. This paper contributes to this growing body of knowledge by identifying not only a role of integrating environmental management in a significant reduction of environmental burden, but also by summarizing all achievable environmental trends and practices as an excellent solutions for achieving sustainability.

REFERENCES

Barrow, J.C. (2006). *Environmental management for sustainable development* (second edition). New York: Routledge.

Bary, J. (2007). *Environment and social theory*. New York: Routledge.

Berg, P.G. (2009). *Timeless Cityland - Building the sustainable human habitat*. Uppsala.

Bonnett, M. (2007). Environmental Education and the Issue of Nature. *Journal of Curriculum Studies, 39*(6), 707-721.

Borojevic, T., Petrovic, N.B., & Vuk, D. (2014). Youth and Environmental Education for Sustainable Development. *International Journal of Science and Research (IJSR), 3*(9), September 2014, 57-62.

Borojević, T., Petrović, N., & Vuk, D. (2015). Aktivizam mladih i zaštita životne sredine. Rad prezentovan na simpozijumu *SYM-OP-IS 2015: XLII Simpozijum o operacionim istraživanjima*, Srebrno jezero. (In Serbian)

Costanza, R. (Ed.) (1991). Ecological Economics: The Science and Management of Sustainability. New York, NY: Columbia University Press.

Costanza, R., & Patten, B.C. (1995). Defining and predicting sustainability. *Ecological economics, 15*(3), 193-196.

Dorney, R.S. (1989). *The Professional Practice of Environmental Management*. New York: Springer.

Dües, C.M., Tan, K.H., & Lim, M. (2013). Green as the new Lean: how to use Lean practices as a catalyst to greening your supply chain. *Journal of Cleaner Production, vol. 40*, 93-100.

Earth Summit. (2002). Retrieved from http://www.earthsummit2002.org/Es2002.pdf.

Ehrenfeld, J. (1994). Industrial ecology: a strategic framework for product policy and other sustainable practices. *In: Swedish Ministry of Environment and natural resources: green goods*. Conference Preparation Document, Second International Conference on Product Oriented Environmental Policy, Saltsjo baden, Stockholm, 1994, 32–68.

International Union for Conservation of Nature - IUCN, U. (1991). World Wide Fund for Nature - WWF (1991). *Caring for the Earth: a strategy for sustainable living*. Gland: IUCN, UNEP, WWF.

Melnyk, S.A., Sroufe, R.P., & Calantone, R.J. (2003). Assessing the impact of environmental management systems on corporate and environmental performance. *Journal of Operations Management, 21*(3), 329-351.

Mert, M. (2006). *Determination of consciousness level of high school students on the environmental training and solid wastes topics: master of education*. Hacettepe University.
Pearce, D.W. & Atkinson, G.D. (1993). Capital theory and the measurement of sustainable development: an indicator of "weak" sustainability. *Ecological economics, 8*, 103-108.
Petrović, N. (2012). *Ekološki menadžment* (drugo izdanje). Beograd: Fakultet organizacionih nauka. (In Serbian)
Petrović, N. (2013). *Upravljanje ekološkom podobnošću proizvoda*. Beograd: Zadužbina Andrejević. (In Serbian)
Pezzey, J. (1989). *Economic Analysis of Sustainable Growth and Sustainable Development*. Environment Department Working Paper No. 15. Washington, DC: The World Bank.
Robert, L., Flood, E. & Carson, R. (1993). *Dealing with complexity*. Plenum.
Roseland, M. (2000). Sustainable community development: integrating environmental, economic, and social objectives. *Progress in planning, 54*(2), 73-132.
Roseland, M. (2005). *Toward Sustainable Communities: Resources for Citizens and Their Governments*. Gabriola Island, Canada: New Society Publishers.
Ross & Associates Environmental Consulting, Ltd. (2004). *Findings and Recommendations on Lean Production and Environmental Management Systems in the Shipbuilding and Ship Repair Sector*. Prepared for The U.S. Environmental Protection Agency National Center for Environmental Innovation, under Contract to ICF Services Company, LLC EPA Contract #68-W-03-028, 2004.
Sharratt, P. (Ed.) (1995). *Environmental Management Systems*. Warwickshire: Institution of Chemical Engineers, Rugby.
Sroufe, R. (2003). Effect of environmental management systems on environmental management practices and operations. *Production and Operations Management Journal 12*(3), 416-431.
Sustainable Measures. (2016). *Definitions of Sustainability*. Retrieved from http://www.sustainablemeasures.com/node/35.
Sustainable Seattle. (2016). *Vision & Mission*. Retrieved from http://www.sustainableseattle.org/about-us/vision-mission/.
United Nations – UN. (2015). *Sustainable development goals*. Retrieved from http://www.un.org/sustainabledevelopment/sustainable-development-goals/.
United Nations – UN. (2016). *What is sustainability*. Retrieved from http://www.un.org/en/sustainablefuture/sustainability.shtml.
United Nations Economic Commission for Europe – UNECE. (1998). *Aarhus convention: Convention on access to information, public participation in decision making and access to justice in environmental matters*. Retrieved from http://www.unece.org/env/pp/treatytext.html.
United States Environmental Protection Agency – EPA. (2016). *Sustainability*. Retrieved from http://www.epa.gov/sustainability/learn-about-sustainability#what.
Vigon, B.W., Tolle, D.A., Cornaby, B.W., Latham, H.C., Harrison, C.L., Boguski, T.L., Hunt, R.G. & Sellers, J.D. (1992). *Life cycle assessment: inventory guidelines and principles*. Cincinnati, Ohio: US EPA No. 600/R-92/036.
Wilson, A.G., & Bryant, L.R. (1997). *Environmental Management: New Directions for the Twenty-First Century*. London: UCL Press.
World Commission on Environment and Development – WCED. (1987). *Our Common Future*. London: Oxford Paperbacks.
Yang, C., Lin, S., Chan, Y., & Sheu C. (2010). Mediated effect of environmental management on manufacturing competitiveness: an empirical study. *International Journal of Production Economics 123*(1), 210-220.

MULTIATTRIBUTE METHODS AS A MEANS FOR SOLVING LAKE POLLUTION PROBLEMS

Bisera Andrić Gušavac, Milena Popović, Ana Katić *
University of Belgrade, Faculty of Organizational Sciences
*Corresponding author, e-mail: katic.ana92@gmail.com

Abstract: *The pollution of lake resources restricts its use for human need or a natural function in the ecosystem. Many lake pollution problems are solved using multiattribute methods, and for some problems, researchers use more than one method to overcome disadvantages of application of only one single method. Short literature review of application of multiattribute methods for lake pollution problems is conducted in this paper. This review pointed out two most commonly used methods for this type of problems - Promethee and AHP method, and therefore basic concept of these methods is presented.*

Keywords*: multiattribute methods, AHP, promethee, water resources, lake pollution*

1. INTRODUCTION

Natural resources are raw materials that come from Earth and exist without any human actions. Water as a natural resource refers to the groundwater and surface water in the environment. Humans have the great need for fresh water which represents around 2.5% of all water on Earth (Postel et al., 1996). Part of fresh water is locked in glaciers and ice caps, and the rest is in lakes, rivers, atmosphere etc. Fresh water can be considered as a renewable resource when the usage, treatment and release of water is in a balance with its capacity, which is necessary for its regeneration. Its significance is reflected in the fact that water is essential precondition for life of humans, animals, plants, etc. Because of that it is important to continuously implement various measures to protect water quality.

In rural areas people usually live around different sources of fresh water and food, which is near mountains, rivers and lakes. As the number of people continuously rises as well as their needs, the pressure on this resources in the environment is much stronger. Human activity is one of the main causes of water resources pollution. These activities lead to fast increase of ecological problems, nature resources and environment in which humans live and act. Biggest problems in rural inhabited areas, especially the ones near sources of fresh water, is the absence or undeveloped sewage systems or proof septic tanks as well as other protection measures which leads to soil contamination.

Rainfall, snowfall or melting of snow are common causes of runoff which is flow of water over earth's surface. Surface runoff can implicate environmental pollution through transport of water pollutants such as chemicals and sediments from roads and ground surface which end up in rivers, lakes or other water streams. On the other hand, groundwater collects contaminants from the soil and supply lakes with high level of nutrients and toxic compounds and makes the water unacceptable for any use and leads to eutrophication.

Eutrophication is one of the most widespread water quality problems in the world. Human negative influence on nature and lack of protection measures for fresh water reservoirs such as lakes, is one of the causes of eutrophication. Its main indicators are excessive plant and algal growth in water body as a response to increased levels of nutrients. This phenomenon indicates that there are crucial structural and functional changes of water ecosystem which result in toxic compounds and lack of oxygen that can cause death of aquatic animals and therefore is not fit for human use.

Eutrophication of waters is the phenomenon of an ecosystem becoming more productive by nutrient enrichment, stimulating primary producers. It is usually characterized by algal blooms, causing water quality deterioration and fish kills. It is becoming a global environmental crisis (Wang & Wang, 2010).

Focus of this paper will be on short review of multiattribute method application on one of the most common fresh water resources that humans use - lake pollution problems. These problems are mainly multiattribute and because of large number of available methods it is necessary to perform a review of multiattribute method applications to similar problems. In that way it is possible to point out most commonly used methods and apply them in purpose of bringing a good decision after reviewing results of different methods.

Multi-criteria decision analysis (MCDA) provides a systematic methodology in combining different inputs in order to rank selected alternatives and compare them. The development of MCDA methods has been motivated not only by a variety of real-life problems requiring the consideration of multiple criteria, but also by practitioners' desire to propose enhanced decision-making techniques using recent advancements in mathematical optimization, scientific computing, and computer technology (Wiecek et al., 2008). This paper pointed out two most commonly used methods for lake pollution problems - Promethee and AHP method. These approaches differ significantly in the way of how values are assigned and combined, meaning that the processes have different information and knowledge requirements and the calculated scores have different mathematical properties and thus slightly different meanings. Practitioners often view one of the various approaches as most appropriate due to the priority they place on its relative strengths and weaknesses (e.g.,Figueira et al., 2005; Beltonand Stewart, 2002).

This paper is organized as follows: literature review of multiattribute methods for lake pollution problems and most important findings are given in section 2. Sections 3 and 4 describe Promethee and AHP methods. Section 5 provides the concluding remarks.

2. MULTIATTRIBUTE METHODS REVIEW FOR LAKE POLLUTION PROBLEMS

It is not the purpose of this paper to give an exhaustive review of multiattribute methods application on the problem of lake pollution. Most of the work in this area is very much oriented towards water resource management, and there are few applications concerning lake pollution. We decided to structure this paper around some carefully selected examples of research studies and research.

Some of common types of water management decisions being supported with multiple criteria analysis techniques include (Hajkowicz & Higgins, 2008):

- Selection of alternative water supply and storage infrastructure options. Eder et al. (1997) use MCA to select locations and design options for hydro-electric power plants on the Danube River in Austria.
- Selection of water restoration or enhancement projects in light of constrained budgets. Al-Rashdan et al. (1999) prioritize projects designed to improve the environmental quality of the Jordan River using MCA.
- Allocating a fixed water resource amongst competing uses. Flug et al. (2000) use MCA to select water flow options for Glen Canyon Dam in Colorado providing for recreation, biodiversity, fishing and cultural uses.
- Selecting water management policies for an entire city or region. Joubert et al. (2003) use MCA to help choose water supply augmentation and demand management policies for the city of Cape Town in South Africa.

Water resource management decisions are typically guided by multiple objectives measured in different units, and therefore makes a multiple criteria analysis (MCA) a well suited decision support tool (Chung, Hong, Lee, & Burian, 2011). Despite an abundance of algorithms to solve an MCA problem once it has been structured, there are few methods to help analysts and decision makers choose criteria and decision options in the first place (Hajkowicz & Collins, 2007).

Water management covers a wide range of activities, in which technical, economic, environmental and social issues are involved (Anagnostopoulos et al, 2005). Given the complexity of the decision process, much attention has been paid to multiple criteria decision-making (MCDM) approaches in order to enhance the ability to make sound decisions in water resources management. Authors in (Anagnostopoulos et al, 2005) discuss that there is no method for choosing among them the most appropriate MCDM methods for a given decision problem and the choice is mostly subjective. Authors evaluate four alternative irrigation projects for the East Macedonia- Thrace District using the AHP and PROMETHEE multicriteria methods. The projects evaluation is based on economic, social, environmental and cost criteria.

More information about different applications of MCDM in water supply management can be found in Lai et al. (2008). For example, MCDM techniques have been applied to optimize policy selection in the remediation of contaminated sites, the reduction of contaminants entering aquatic ecosystems, the optimization of water and coastal resources, and the management of other resources (Huang et al., 2011).

From a wide range of MCDM methods, the most suitable ones for the design of alternative comparison are PROMETHEE and AHP (Balali, Zahraie & Roozbahani, 2014), and therefore we conducted a short survey on these methods regarding water resource problems, especially problems related to lake management.

AHP is widely used in water resources industry. For example, management and planning for a large watershed may include issues related to water quality and quantity, forest management, wildlife

management, and recreation. Input is required from subject matter experts in each of these disciplines in order to establish priorities and make informed decisions regarding spatial and temporal distributions of resources. In addition to its breadth of application, the AHP is relatively easy to apply, to understand, and to interpret (Schmoldt et al., 2013).

Authors in (Sener et al., 2010) select a landfill site for the Lake Beysehir catchment area in such way that the lake is protected. The Beysehir Lake is the largest freshwater lake and drinking water reservoir in Turkey. To determine the most suitable landfill site that must combine social, environmental and technical parameters, an AHP was combined with a geographic information system (GIS) to examine several criteria, and each criterion was evaluated with the aid of AHP.

In (Li, 2007) author researches the system that involves defining indicators in the following fields: society, economy, resources, environment and ecology. These indicators are proposed for eco-environmental quality assessment in Chaohu Lake basin. A hierarchical model with four levels is established and the weights of indicators and attributes are determined by combining Delphi method with the AHP.

In (Su et al, 1997) AHP was applied in water environmental quality assessment of the Songhua River, and the authors show that it has logicality, practicability and system that are appropriate to the real water environmental quality assessment.

The AHP provides a systematic method for comparison and weighting multiple criteria and alternatives that exists in integrated watershed management. An advantage of the AHP is that it is capable of providing numerical weights to options where subjective judgments of either quantitative or qualitative alternatives constitute an important part of the decision process. Such is often the case with IWM (De Steiguer et al.,, 2003).

Eutrophication is the most widespread water quality problem in many countries. Symptoms such as high level of chlorophyll, an excessive seaweed blooms, occurrence of anoxia and hypoxia have occurred in many areas in China (Xing, 2005). Evaluation of the trophic state of a lake is in fact a multivariate comprehensive decision making process quantifying the qualitative problem. Authors in (Xing et al., 2005) choose the trophic state index in order to assess the trophic state of the Lake Dianchi and they use AHP for weights calculation of the pollution indicators.

Authors in (Zhang, 2007) evaluate environmental comprehensive quality of water and sediment of Xuanwu Lake, Nanjing, China. An improved AHP method had been developed and the weights of pollution factors were completely related to the objective monitoring data through the standardization of these procedures. This improved AHP method can avoid arbitrariness of subjective judgment and can reflect the real influential factors of environment pollution in different periods or regions (Zhang et al., 2007).

Many water quality management decisions involve uncertain information, multiple and often conflicting objectives, and limited resources. In (Korfmacher, 1997) author presents an application of AHP to the selection of a water quality model for Lake Okeechobee in Florida. The aim of selected water quality model is to help guide research and management efforts at reducing algal blooms on the lake.

Authors in (Calizaya et al., 2010) apply AHP to solve the MCDA problem in the Lake Poopo basin and to identify the alternatives using the highest expected utility value in order to support stakeholders in managing their water resources.

In the study conducted by Hajkowicz and Collins (Hajkowicz & Collins, 2007) eight types of MCA application in water resource management were identified, and by reviewing the characteristics of the problem considered in this paper, two types of applications are a match:

- Project appraisal. These studies use MCA to rank or score a set of water management projects which often involve some form of water condition restoration activity. For example, Al-Rashdan et al. (1999) use Promethee and Nominal Group Technique to prioritize a set of projects aimed to improve the environmental quality of the Jordan River.
- Water quality management. These papers involved an application of MCA primarily involving the evaluation of options aimed specifically at improving water quality. They often involve human and ecosystem health objectives. An example comes from Lee and Chang (2005) where MCA is used to develop a water quality management plan for the Tou–Chen River Basin in northern Taiwan.

Papers reviewed in (Hajkowicz & Collins, 2007) employed 61 unique MCA techniques. The majority of studies applied more than one MCA method, usually to test the sensitivity of the result and in the authors

point out that the most commonly applied methods were fuzzy set analysis, compromise programming (CP), the analytic hierarchy process (AHP), ELECTRE and PROMETHEE.

In (Abu-Thaleb & Mareschal, 1995) authors describe the application of the PROMETHEE V multicriteria method to evaluate and select from a variety of potentially feasible water resources development options, so that the allocation of limited funds to alternative development projects and programs can proceed in the most efficient manner. The criteria set indicates that a successful combination of water options must include projects and programs that minimize groundwater extraction, ensure groundwater quality and quantity, have a high probability of cost recovery, maximize the supply of water and promote water conservation and efficiency.

A list of the papers on the topic of Hydrology and Water Management can be found in (Behzadian et al., 2010) and, according to the authors, most of the papers have been devoted to the sustainable water resources planning, water management strategies assessment, and irrigation planning using PROMETHEE applications.

3. PROMETHEE METHOD

The PROMETHEE method (Preference Ranking Organization Method for Enrichment Evaluations) is one of the most recent multi-criteria decision aid methods, developed by Brans in 1982 (Brans, 1982). The PROMETHEE includes PROMETHEE I for partial ranking of alternatives and PROMETHEE II for complete ranking of alternatives.

The basic principle of PROMETHEE II is based on a pair-wise comparison of alternatives along each recognized criterion. Alternatives are evaluated according to different criteria, which have to be maximized or minimized. The implementation of the PROMETHEE II requires two additional types of information (Behzadian, M., et al., 2010):

- Information on the relative importance (i.e. the weights) of the criteria considered. PROMETHEE II assumes that the decision-maker is able to weight criteria appropriately, at least when the number of criteria is not too large (Macharis, J., et al., 2004);
- Information on the decision-makers' preference function, which decision maker uses when comparing the contribution of the alternatives in terms of each separate criterion. In order to facilitate the selection of a specific preference function, Vincke and Brans (1985) proposed six basic types of criteria: (1) usual, (2) U-shape, (3) V-shape, (4) level, (5) V-shape with indifference and (6) Gaussian (Brans & Vincke, 1985). These six types are particularly easy to define. For each criterion, the value of an indifference threshold, *q*, the value of a strict preference threshold, *p*, and the value of an intermediate value between *p* and *q*, *s*, has to be defined (Brans & Mareschal, 2003).

Experts' opinions are set on various parameters such as selection and weight of the criteria. The team of experts who has cooperated in this research includes architects and information managers who are involved in hotel building design and operational research projects. The PROMETHEE method is implemented in five steps (Behzadian, M., et al., 2010):

Step 1. Determination of deviation based on pair-wise comparison (1):

$$d_j(a,b) = g_j(a) - g_j(b);\ \ j = 1,...,n \tag{1}$$

Where $d_j(a,b)$ denotes the difference between the evaluation of *a* and *b* on each criterion.

Step 2. Application of the preference function (2):

$$P_j(a,b) = F_j\left\lfloor d_j(a,b)\right\rfloor;\ \ j = 1,...,n \tag{2}$$

Where $P_j(a,b)$ denotes the preference of alternative *a* with regard to alternative *b* on each criterion, as a function of $d_j(a,b)$

Step 3. Calculation of an overall or global preferences index (3):

$$\forall a,b \in A,\ \pi(a,b) = \sum_{j=1}^{n} P_j(a,b)w_j \tag{3}$$

Where $\pi(a,b)$ of *a* over *b* (from 0 to 1) is defined as the weighted sum $p(a,b)$ of for each criterion, and w_j is the weight associated with j^{th} criterion.

Step 4. Calculation of outranking flows/ The PROMETHEE I partial ranking (4):

$$\phi^+(a)=\frac{1}{n-1}\sum_{x\in A}\pi(a,x) \text{ and } \phi^-(a)=\frac{1}{n-1}\sum_{x\in A}\pi(a,x) \quad (4)$$

Where $\phi^+(a)$ and $\phi^-(a)$ denote the positive outranking flow and negative outranking flow for each alternative, respectively.

Step 5. Calculation of net outranking flow/ The PROMETHEE II complete ranking (5):

$$\phi(a)=\phi^+(a)-\phi^-(a) \quad (5)$$

Where $\phi(a)$ denotes the net outranking flow for each alternative.

4. THE ANALYTIC HIERARCHY PROCESS (AHP)

Analytic Hierarchy Process – AHP was developed by Thomas Saaty in the early '70s of the last century (Saaty, 1977; 1980), in order to solve complex problems whose elements are: objectives, criteria, sub-criteria and alternatives. It is popular and widely used method for organizing and analyzing complex decisions, based on mathematics and psychology. AHP considers quantitative and qualitative attributes and combines them through the decomposition of complex problems into a model that has the form of a hierarchy. Each level of the hierarchy consists of elements that are influenced by the level above and which can be mutually compared hierarchically structured model of decision-making is generally made up of objectives, criteria and alternatives. The objective is on the top of the hierarchy, the criteria are compared to one another in relation to the set objective, while at the last level, the comparison of alternatives is made in relation to the criteria. AHP keeps all parts of the hierarchy in a relationship, so it is easy to see how a change in one factor affects other factors.

The main objective of this method is ranking of several alternatives, as well as the choice of the best one from a set of available ones, in situations where decision-making involves a larger number of decision makers, and where there are a larger number of criteria in different time-periods. The ranking/selection is made in relation to the set target.

The methodology of the AHP can be explained in following steps (Saaty, 1977; 1980):

Step 1: The problem is decomposed into a hierarchy of goal, criteria, sub-criteria and alternatives.

Step 2: Data are collected from experts or decision-makers corresponding to the hierarchic structure, in the pairwise comparison of alternatives on a qualitative scale. Experts can rate the comparison as equal, marginally strong, strong, very strong, and extremely strong.

Step 3: The pairwise comparisons of various criteria generated at Step 2 are organized into a square matrix. The diagonal elements of the matrix are 1. The criterion in the *i*-th row is better than criterion in the *j*-th column if the value of element (*i, j*) is more than 1; otherwise the criterion in the *j*-th column is better than that in the *i*-th row. The (*j, i*) element of the matrix is the reciprocal of the (*i, j*) element.

Step 4: The principal eigenvalue and the corresponding normalized right eigenvector of the comparison matrix give the relative importance of the various criteria being compared. The elements of the normalised eigenvector are termed weights with respect to the criteria or sub-criteria and ratings with respect to the alternatives.

Step 5: The consistency of the matrix of order n is evaluated. Comparisons made by this method are subjective and the AHP tolerates inconsistency through the amount of redundancy in the approach. If this consistency index fails to reach a required level then answers to comparisons may be re-examined. The consistency index, *CI*, is calculated as:

$$CI=(\lambda_{\max}-n)/(n-1) \quad (6)$$

where $\lambda_{\max}$ max is the maximum eigenvalue of the judgment matrix. This *CI* can be compared with that of a random matrix, *RI*. The ratio derived, *CI/RI*, is termed the consistency ratio, *CR*. Saaty (Saaty, 1977; 1980) suggests the value of *CR* should be less than 0.1.

Step 6: The rating of each alternative is multiplied by the weights of the sub-criteria and aggregated to get local ratings with respect to each criterion. The local ratings are then multiplied by the weights of the criteria and aggregated to get global ratings.

The AHP produces weight values for each alternative based on the judged importance of one alternative over another with respect to a common criterion.

5. CONCLUSION

Decision making in urban environmental management can be complex, principally because of the inherent trade-offs between environmental, ecological and economic factors. The eutrophication is natural phenomenon, and during the last 3 decades there are many techniques used in eutrophication problem-solving (Svircev, Krstic, Markovic, Plavsa & Lazic, 2008).

Eutrophication of lakes and reservoirs is a degradation process originating from the introduction of nutrients from agricultural run-off and untreated industrial and urban discharges. Accelerated eutrophication of lakes and reservoirs experiencing during last century in most parts of the world represents a serious degradation of water quality (Qin, 2009).

Application of multicriteria decision analysis in water resource management is widespread and growing (Hajkowicz & Collins, 2007). The use of MCDA techniques provides a reliable methodology to rank alternative, but none of them is considered the best for all kinds of decision-making situations. Based on Balali et al., (Balali, Zahraie & Roozbahani, 2014), we conducted a short survey on the PROMETHEE and AHP methods regarding water resource problems, especially problems related to lake management.

There aren't many applications of MCDA methods for lake eutrophication problem, but the studies conducted for the lake management problems are applicable to this particular problem. The literature review illustrated the value of the approach, but refinement and validation of the methods must continue such that they can eventually be incorporated into policy making. Recommendations for further research include real case application of selected methods for the eutrophication lake problem.

REFERENCES

Abu-Taleb, M. F., & Mareschal, B. (1995). Water resources planning in the Middle East: application of the PROMETHEE V multicriteria method.European journal of operational research, 81(3), 500-511.

Al-Rashdan, D., Al-Kloub, B., Dean, A., & Al-Shemmeri, T. (1999). Environmental impact assessment and ranking the environmental projects in Jordan. European Journal of Operational Research, 118(1), 30-45.

Anagnostopoulos, K., Petalas, C., & Pisinaras, V. (2005). Water resources planning using the AHP and Promethee multicriteria methods: The case of nestos river-Greece, Retrived from: http://www.anmb.ro/ro/conferinte/bacor/Section4/ANAGNOSTOPOULOS-PETALAS-PISINARAS.pdf.

Balali, V., Zahraie, B., & Roozbahani, A. (2014). A comparison of AHP and PROMETHEE family decision making methods for selection of building structural system. American Journal of Civil Engineering and Architecture, 2(5), 149-159.

Behzadian, M., Kazemzadeh, R. B., Albadvi, A., & Aghdasi, M. (2010). PROMETHEE: A comprehensive literature review on methodologies and applications. European journal of Operational research, 200(1), 198-215.

Belton V, Stewart TJ. Multiple Criteria Decision Analysis: an integrated approach. NewYork: Springer; 2002.

Brans, J. P., & Mareschal, V. B. (2003). How to select and how to rank projects: The PROMETHEE method, European Journal of Operational Research, 24 (2), 228-238

Brans, J. P., & Vincke, P. (1985). A preference ranking organization method (The PROMETHEE method for multiple criteria decision making), Management Sciences, 31, 647-656.

Brans, P. (1982). Preference ranking organization method for enrichment valuations (in French language). Colloque D' aide' la De´cision. Que´bec: Universite´ Laval, 183–213.

Calizaya, A., Meixner, O., Bengtsson, L., & Berndtsson, R. (2010). Multi-criteria decision analysis (MCDA) for integrated water resources management (IWRM) in the Lake Poopo Basin, Bolivia. Water resources management, 24(10), 2267-2289.

Chung, E.S.· Hong, W.P. Lee, K.S. & Burian, S. J. (2011). Integrated Use of a Continuous Simulation Model and Multi-Attribute Decision-Making for Ranking Urban Watershed Management Alternatives, Water Resource Management, 25, 641–659.

De Steiguer, J. E., Duberstein, J., & Lopes, V. (2003, October). The analytic hierarchy process as a means for integrated watershed management. InKenneth G Renard, First Interagency Conference on Research on the Watersheds, 736-740.

Eder, G., Duckstein, L., & Nachtnebel, H. P. (1997). Ranking water resource projects and evaluating criteria by multicriterion Q-analysis: an Austrian case study. Journal of Multi-Criteria Decision Analysis, 6(5), 259-271.

Figueira J, Greco S, Ehrgott M. (2005). Multiple Criteria Decision Analysis: state of the artsurveys. New York: Springer.
Flug, M., Seitz, H. L., & Scott, J. F. (2000). Multicriteria decision analysis applied to Glen Canyon Dam. Journal of Water Resources Planning and Management, 126(5), 270-276.
Hajkowicz, S., & Higgins, A. (2008). A comparison of multiple criteria analysis techniques for water resource management. European journal of operational research, 184(1), 255-265.
Hajkowicz, S., & Collins, K. (2007). A review of multiple criteria analysis for water resource planning and management. Water resources management,21(9), 1553-1566.
Huang, I. B., Keisler, J., & Linkov, I. (2011). Multi-criteria decision analysis in environmental sciences: ten years of applications and trends. Science of the total environment, 409(19), 3578-3594.
Joubert, A., Stewart, T. J., & Eberhard, R. (2003). Evaluation of water supply augmentation and water demand management options for the City of Cape Town. Journal of Multi-Criteria Decision Analysis, 12(1), 17-25.
Korfmacher, K. S. (1997). Selection of a model for algal blooms on Lake Okeechobee: An application of decision analysis using the analytic hierarchy process (AHP). Lake and Reservoir Management, 13(1), 38-43, DOI: 10.1080/07438149709354294.
Li, R. (2007). Dynamic assessment on regional eco-environmental quality using AHP-statistics model—A case study of Chaohu Lake Basin. Chinese Geographical Science, 17(4), 341-348.
Macharis, C., Springael, J., De Brucker, K., & Verbeke, A. (2004). PROMETHEE and AHP: The design of operational synergies in multicriteria analysis: Strengthening PROMETHEE with ideas of AHP, European Journal of Operational Research, 153 (2), 307-317.
Postel S., Daily G. & Ehrlich P. (1996). Human appropriation of renewable fresh water. Science 271.5250
Qin, B. (2009). Lake eutrophication: control countermeasures and recycling exploitation. Ecological Engineering, 35(11), 1569-1573.
Saaty, T.L. (1977). A scaling method for priorities in hierarchical structures, Journal of Mathematical Psychology, 15:234-281.
Saaty, T.L. (1980). The Analytic Hierarchy Process, McGraw Hill, New York.
Schmoldt, D., Kangas, J., Mendoza, G. A., & Pesonen, M. (Eds.). (2013).The analytic hierarchy process in natural resource and environmental decision making (Vol. 3). Springer Science & Business Media.
Şener, Ş., Şener, E., Nas, B., & Karagüzel, R. (2010). Combining AHP with GIS for landfill site selection: a case study in the Lake Beyşehir catchment area (Konya, Turkey). Waste Management, 30(11), 2037-2046.
Su, D. L., Wu, B., & Shen, J. (1997). The AHP of water environment quality assessment. Journal of Harbin Institute of Technology, 29(5), 105.
Svircev Z, Krstic S, Markovic S, Plavsa J, Lazic L (2008). Methods for. Management of Eutrophication in Freshwater Ecosystems in. Vojvodina, Geographica Pannonica, 12 (1), 4–11.
Vujosevic, M. L., & Popovic, M. J. (2015). The comparison of the energy performance of hotel buildings using PROMETHEE decision-making method. Thermal Science, (00), 98-98.
Wiecek, M.M., Ehrgott, M., Fadel, G., Figueira, J.R., 2008. Editorial: Multiple criteriadecision making for engineering. Omega 36, 337–339.
Xing, K., Guo, H., Sun, Y., & Huang, Y. (2005). Assessment of the spatial-temporal eutrophic character in the Lake Dianchi. Journal of Geographical Sciences, 15(1), 37-43.
Zhang, Y., Zhang, H., Gao, X., & Peng, B. (2007). Improved AHP method and its application in lake environmental comprehensive quality evaluation—a case study of Xuanwu Lake, Nanjing, China. Chinese Journal of Oceanology and Limnology, 25, 427-433.
Wang, H., & Wang, H. (2009). Mitigation of lake eutrophication: Loosen nitrogen control and focus on phosphorus abatement. Progress in Natural Science, 19(10), 1445-1451.

REACHING ENERGY EFFICIENCY THROUGH ENVIRONMENTALLY RESPONSIBLE HARDWARE AND SOFTWARE DEVELOPMENT

Matija Milekić[1], Marko Ćirović[1] Nataša Petrović [1]
[1]University of Belgrade Faculty of Organizational Sciences

Abstract: *Today's world is overflowing with electronic devices. There are more electronic devices in the world than humans. Such proliferation of electronic devices is increasing the electric energy consumption. As a result there are high levels of environmental degradation coming out of the increased energy demand. Considering that further proliferation of electronic devices is expected, the means of reaching more energy efficient electronic devices are examined. This paper analyses both hardware and software development options that can lead to lower energy demand. The aim is to evaluate practices of how hardware components are being built and the necessary inclusions in order to achieve a higher level of energy efficiency, as well as the kind of software development guidelines which should be followed in order to reach the same goal. Finally the paper answers the question of whether there are certain tradeoffs in pursuing the desired ends.*

Keywords*: environment, ecology, energy efficiency, smart computing*

1. INTRODUCTION

We are currently living in a world where pollution as a problem is growing worldwide. It's becoming something that is affecting both flora and fauna. By destroying natural habitats it is making conditions even worse for humans and animals alike. Numerous causes have led to these conditions. These examples are listed below (Bose, 2010):

- Air pollution is the most dangerous form of pollution. It is caused by many factors. Uncontrolled burning of fuel which is essential for our everyday lives and industrial activities; which emits an enormous amount of chemical substances in the air every day;
- Water pollution occurs due to several factors; the industrial waste dumped into the rivers and other water bodies cause an imbalance in the water leading to its severe contamination and death of both marine flora and fauna.
- Soil pollution is occurring due to the unwanted chemicals being absorbed in to the soil due to human activities. The use of insecticides and pesticides absorbs the nitrogen compounds from the soil making it unfit for plants to derive nutrition from.

Another cause which is appearing in the 21st century is the fact that now there are more electronic devices than humans which is increasing the electric energy consumption. Nowadays almost everyone has a computer because of the mass production and reasonable prices which are not helping the situation. The ICT's share in electricity consumption in national economy scales has continuously increased during the past decades (Kohler & Erdmann, 2004).

Three types of environmental degradation are caused by ICT products and infrastructures can be discerned: global resource depletion, energy use, and the emission of toxic substances over the lifecycle (consisting of production, use and disposal). For example, to make a single 32 MB DRAM memory chip of approximately 2 grams you need: 1.6 kg of fossil fuels, 27 g of diverse chemicals, 700 g of elemental gases, and 32 kg of fresh water. On top of that, to combine all of these materials we also need 41 MJ of energy per chip in the production chain of silicon wafers (Williams, Ayres, & Heller, 2002). For a complete personal computer including a CRT-monitor, the input of abiotic raw materials goes up to 1500 kg (Köhler & Erdmann, 2004).

And last but not the least important problem is the ignorance of people and their attitude that only the big companies are the ones who are polluting and destroying the environment. They are not aware that by looking after their consumption they can help a lot and make a big difference if we look at the population of one city or region.

In the last couple of decades, important attempts have been made to decrease the net power and energy consumption of electronic devices especially those which are battery powered. The idea of low-power hardware construction is a dominant field of research and multiple attempts for power and energy minimization and reduction have been made. However, since most of the hardware functions are controlled

by software, it is of fundamental importance to study the software impact on the hardware energy consumption (Großschädl, Avanzi, Savaş, & Tillich, 2005).

In information communication technologies, when arguing the modes of reaching energy efficient computing authors note two main fields with room for improvement, these being:
- Energy efficient hardware development
- Energy efficient software development

When considering energy efficient software development, guidelines for such software development are a relatively novel area of study, but they are continually improving, with the biggest concerns centered on the trade-off of performance versus energy efficiency. Different authors propose different approaches to overall energy efficient software development, but they all center around three specific goals (Roy & Johnson, 1997):
- reduction of the cost or frequency of memory accesses,
- selection of the least expensive instructions or instruction sequences,
- processor-specific optimizations.

When talking about energy efficient hardware development, for such development, a very important question of how to save energy comes to mind. Can we predict how much energy we are using, by determining our total energy consumption? (Landsiedel, Wehrle, & Götz, 2005).

2. IMPLEMENTATION AND SIGNIFICANCE

Goodman (2000) notes that today's processors come with an option of adjustable clock frequency and supply voltage. The adjustable voltage-frequency properties can be used with an appropriate voltage scheduler which decreases the energy usage in the period when computer response is less needed. It is possible to simultaneously dynamically adjust the supply voltage and clock rate of the processor in order to significantly reduce the energy consumption of the CPU during periods of low activity in which the computer user does not require full operability.

Phase-change memory (PCM) is one of the alternative types of memory that can replace flash memory in next-generation non-volatile memory devices. (Derbyshire, 2011; Wuttig & Yamda, 2007; Hamann, O'Boyle, Martin, Rooks, & Wickramasinghe, 2006). A phase-change material such as chalcogenide can be reversibly shifted between its crystalline and amorphous states through heating by applying appropriate voltage pulses, which cause a change in the resistance state. (Wuttig and Yamda, 2007; Loke, Lee, Wang, Shi, Zhao, Yeo, & Elliott, 2012). The measure of merit, with high switching speed, good endurance, excellent retention properties, low fabrication cost, and inherent scalability, makes PCM more appealing than flash memory. (Loke et al., 2012).

There are different kinds of research being conducted, concentrating on separate parts of the computer system and as a result of that these parts are being optimized independently (Tiwari, Malik, Wolfe, & Lee, 1996), which leads to dubious interpretations. On one hand it can be noted that in this way higher efficiency can be reached, while studies show that independent optimizations of system parts are less efficient and can be counterproductive (Wood & Newborough. 2005). For example Landsiedel et al., (2005) show that passive RFID system protocols must not be assessed independently because it leads to less accuracy, unless they are evaluated in the context of their codependence on implementing circuits they run on. This is due to the fact that both the circuit and the protocols have to be adjusted in their energy consumption efficiency based on their designed physical limitations, therefore meaning that both parts of the system have to be addressed simultaneously.

Different studies have researched the energy consumption of CPUs during different operating tasks including: sensing, routing, sending and receiving information, all being main CPU activities. Such studies present the opportunity to identify and address the energy consumption demanded by different procedures and most importantly the procedures that require the highest energy consumption. Landsiedel, et al. (2005) note that low level data handling, scheduling and timer handling consume are at the top of the list of procedures by the level of energy they consume just swing by a mere fact that they are not time efficient and hence demand longer processing. This has led authors to conclude that in order to increase energy efficiency in these procedures, the time that the processor spends dealing with them has to be decreased, and more specifically it means that in order to improve sensor node applications, energy efficiency ratio and the operating system implementation has to be improved. (Landsiedel et al., 2005).

3. HOW MUCH ENERGY ARE WE TALKING ABOUT?

If we were to apply a smart metering technology in our houses we would not only improve our knowledge of the appliances in our home, but would also start making our energy consumption more efficient. These devices would measure the electricity consumption of up to 16 the home appliances. The data would be transferred from the appliance to a main local collector unit (LCU) using radio waves. Each LCU stores a meter identity number and the current meter reading and the central POEM unit collects data from the LCU. The data is then sent down the telephone line for analysis elsewhere, when the phone is not in use. This system is purely a data collection system and the presentation of energy information to the customer is not its primary function. Marvin, Chappells, and Guy (1999), suggests that smart meter technologies could potentially help consumers to use their energy more effectively. The application of smart metering technologies in-home has the potential to reduce gas and electricity consumption and carbon emissions as well as domestic fuel bills (Darby, 2006). Cook (1979) reported a 12% decrease in electricity usage in households with an FEM

Additionally studies have shown that when pervasive computing is considered, the environmental impact that comes to be analysed in correlation with it, it can be noted that there are different degrees of ICT impacts to the environment. These impacts can be classified in three levels of environmental impact (Fichter, 2001; Schauer, 2003; Köhler & Erdmann, 2004):

- First-order effects: These include all environmental impacts that are a resulting consequence of ICT hardware lifecycle, starting from the idea, design plan, construction, production, usage and the final disposal.
- Second-order effects: These are the impacts that come as a cascade consequence of ICT usage. The use of ICT causes parallel processes that are also leaving an impact to the environment. With regard that many hardware components' production has been moved overseas in recent decades due to cheaper labor. The shipping of these components and industrial production and extraction of raw materials needed for the production are also having a huge impact and are usually left understated.
- Third-order effects: as a result of the proliferated use of ICT in daily life, economic structures and their many outcomes still cannot be predicted, in spite of their indirectly manifestation the expression of first- and second-order effects.

Due to the fact that ICT plays on increasingly important role within the everyday societal behavior it is of the highest importance to accurately measure the performance of all sorts of electronic devices. This is especially important when all sorts of ICT networks are in question such as sensor networks since energy is a scarce resource. The factor of the biggest significance to be measured is energy consumption, and evaluation of abilities for reaching higher energy efficiency of hardware is crucial, as well as finding ways of producing more durable hardware and hardware with a longer life span as well as introducing protocols that will be less time consuming for the CPUs. Products and devices now commonly come embedded with their environment which at the point when energy circuits stop functioning demands disposal of the entire devices just because parts of them are not responding, leading to product replacement and then consequently to a marked increase in usage of new raw materials for making new products. In the long run the entire process demands a behavioral change as well as a change in terms of how we perceive ICT devices and how we address their further usage (Landsiedel et al., 2005).

4. DISSCUSION

The growing demand for electronic devices, especially mobile ones, will continue to exist in the future as well. Considering that such growth is a result of several aspects, how we as a society deal with that will be of utmost importance. The causes are various; on the one hand we have been witnessing the change of lifestyle worldwide where individuals used to be able to participate within social structures offline, without missing out on their social and economical wellbeing. Nowadays in western capitalist liberal societies it is almost unimaginable to fully be integrated into society, work environment, and maintain a culturally relevant information feed without constantly being online. This has caused and will continue to cause dependence on electronic devices. Simultaneously, within these cultures the exists a general dependence on electronic devices, home appliances, and especially CPU run platforms and computers which will only continue to rise. On the other hand we see that societies that haven't had that kind of early ICT influence proliferation are heading the same route.

As the number of devices will increase inevitably the issue that has to be addressed is how these devices will be powered, or more specifically from which sources the energy will be drawn. Regarding that the global energy demand is expected to increase significantly in the upcoming decades. Moreover, in a world with a growing resource scarcity the main question that comes up is the ability to utilise present resources more efficiently.

More efficient energy usage is definitely one of the prime environmental questions, shifting from traditional energy resources such as fossil fuels will decrease the global carbon footprint enormously, but that does not mean that the story ends there. Regarding the growing global population and the expected average number of electronic devices per capita even though shifting to alternative energy sources will help in fighting environmental degradation, hardly will it suffice as an isolated act. Additional steps are necessary. Although alternative energy sources are clean in comparison to fossil fuels, that doesn't mean they are stripped of all the negative environmental effects. Reaching energy efficiency on a micro level just might give the desired results on a global level.

5. **CONCLUSION**

In the end it has to be noted that with growing pollution levels resulting from the increase in resource exploitation for the sole purpose of generating energy for powering regular daily activities dependent on CPU run electronic devices has to be addressed.

There are two ways of addressing it that are predominant in literature. One is by addressing the sources of energy, while the other is by addressing the demand itself.
Addressing the demand itself is contingent on two factors as well. The first factor is advocating a change in behavioural habits by raising the awareness of the issue. The second, from the point of view of this paper, is that although some behavioural changes are possible the civilisation is hardly going back to acknowledging the offline mode. This means that energy efficiency of the observed devices will become the most important issue regarding the entire problem presented here.

It can be stated that individual improvements of computer systems can give desired results, but in order to achieve optimal efficiency a holistic approach to ICT has to be endorsed. This is the reason why many authors advocate, both hardware and software development which is more energy responsible. In terms of hardware it can be concluded that adjustable supply voltage and clock rate system protocols made simultaneously can lead to creating more energy efficient computer units. In terms of software, changing the energy demand is based on creating the software with operations that demand less processing time and are less display intensive while also combining the operations that can be done simultaneously.

Finally, for many years it was thought that in order to achieve everything mentioned above tradeoffs in terms of user satisfaction are necessary. It therefore has to be concluded that such tradeoffs in terms of user experience might have been the issue in earlier stages of ICT development when CPU units were much slower, and hardware in general less durable. Nowadays this isn't the issue any more and especially with further development of the entire branch such tradeoffs will become scarce if any.

References

Bose, B. K. (2010). Global warming: Energy, environmental pollution, and the impact of power electronics. Industrial Electronics Magazine, IEEE, 4(1), 6-17.

Cook, S. W. (1979). Energy conservation effects of continuous in-home feedback in all-electric homes. Journal of Environmental Systems, 9(2), 169-173.

Darby, S. (2006). The effectiveness of feedback on energy consumption. A Review for DEFRA of the Literature on Metering, Billing and direct Displays,486, 2006.

Derbyshire, K. (2011). ITRS 2010: a more-than-moore roadmap?. Solid State Technology, 54(3), 7-8.

Goodman, J. R. (2000). Energy scalable reconfigurable cryptographic hardware for portable applications (Doctoral dissertation, Massachusetts Institute of Technology).

Großschädl, J., Avanzi, R. M., Savaş, E., & Tillich, S. (2005). Energy-efficient software implementation of long integer modular arithmetic. In Cryptographic Hardware and Embedded Systems–CHES 2005 (pp. 75-90). Springer Berlin Heidelberg.

Hamann, H. F., O'Boyle, M., Martin, Y. C., Rooks, M., & Wickramasinghe, H. K. (2006). Ultra-high-density phase-change storage and memory. Nature materials, 5(5), 383-387.

Köhler, A., & Erdmann, L. (2004). Expected environmental impacts of pervasive computing. Human and Ecological Risk Assessment, 10(5), 831-852.

Landsiedel, O., Wehrle, K., & Götz, S. (2005). Accurate prediction of power consumption in sensor networks. In Proc. of the Second Workshop on Embedded Networked Sensors.

Loke, D., Lee, T. H., Wang, W. J., Shi, L. P., Zhao, R., Yeo, Y. C., & Elliott, S. R. (2012). Breaking the speed limits of phase-change memory. Science,336 (6088), 1566-1569.

Marvin, S., Chappells, H., & Guy, S. (1999). Pathways of smart metering development: shaping environmental innovation. Computers, Environment and Urban Systems, 23(2), 109-126.

Roy, K., & Johnson, M. C. (1997). Software design for low power. In Low power design in deep submicron electronics (pp. 433-460). Springer US.

Tiwari, V., Malik, S., Wolfe, A., & Lee, M. T. C. (1996). Instruction level power analysis and optimization of software. In Technologies for wireless computing (pp. 139-154). Springer US.

Williams, E. D., Ayres, R. U., & Heller, M. (2002). The 1.7 kilogram microchip: energy and material use in the production of semiconductor devices. Environmental science & technology, 36(24), 5504-5510.

Wood, G., & Newborough, M. (2003). Dynamic energy-consumption indicators for domestic appliances: environment, behaviour and design.Energy and Buildings, 35(8), 821-841.

Wuttig, M., & Yamada, N. (2007). Phase-change materials for rewriteable data storage. Nature materials, 6(11), 824-832.

SELECTION OF EFFICIENT LOCATIONS FOR MEDICAL WASTES INCINERATION PLANTS

Kristina Stanojević*[1], Dragana Makajić Nikolić [1], Gordana Savić[1]
[1]University of Belgrade – Faculty of Organizational Sciences, Serbia
* Corresponding author, e-mail: kristina.stanojevic@fon.bg.ac.rs

Abstract: *The aim of this paper is to propose a methodology for selection of potential locations for facilities to incineration of medical waste. Medical waste is one special kind of hazardous wastes. If mishandled, it could cause disease spread and pollution of air and soil. The Republic of Serbia at the moment disposes medical waste on landfills or exports it to countries that have incineration facilities. Different factors can affect the selection of a suitable location for incineration facilities. These factors must be considered concurrently for the identification of efficient facilities locations. In this paper we use data envelopment analysis (DEA) as an approach for selection of locations for medical wastes incineration plants.*

Keywords*: medical waste, Incineration, data envelopment analysis (DEA), efficient locations, selection of district*

1. INTRODUCTION

National guide for safe medical waste management considers medical waste as every waste that originates from medical, dental, veterinarian, pharmaceutical or similar practices. This waste is a heterogeneous mix of simple garbage, infective waste, pathology and anatomy waste, pharmaceutical and laboratory waste, disinfectants and packaging, as well as radioactive and hazardous chemical waste. Medical waste may consist (partially or fully) of human or animal tissues, blood and other body fluids, secretion and excreta, medicines and other pharmaceutical products, swabs, cotton pads, gauze, bandages, needles, scalpels and other sharp instruments (Ministry of health of Republic of Serbia (MoH RS), 2008). In European catalogue, medical waste is registered under number 18 00 00 with subsets (SG, 2010a)

Until 2007 year, medical waste was sterilized in certain health institutions, most common in autoclaves that were very old. In health institutions, that were not able to sterilize medical waste, it was mixed with communal waste and disposed at city landfills (MoH RS, 2008). Ministry of health of Republic of Serbia together with the Ministry of agriculture and environmental protection, in the year 2007 started a project of "Technical support in medical waste management". Project was financed by the European Union, and in 72 medical centers, 78 autoclaves and shredders for medical waste sterilization were installed. Also, 25 vehicles for transport of medical waste were purchased, and conducted the training of workers for classification of generated medical waste. Apart from installed autoclaves and shredders for sterilization of medical waste, in the Republic of Serbia there are no modern facilities for medical waste treatment (SG, 2010b).

Hazardous medical waste that cannot be treated or disposed in an environmentally sound and efficient manner, due to the lack of technical capabilities and facilities in the Republic of Serbia, is being exported for treatment or disposal, in accordance with the law and regulations governing waste management, or international transport of waste (SG, 2010c).Trans boundary movements and disposal of medical waste is regulated by Basel Convention on the Control of Trans boundary Movements of Hazardous Wastes and their Disposal (1989). The agreement implies that the only legitimate transportation of hazardous waste is exported from the countries that do not have waste treatment facilities or qualified staff for safe disposal of waste, to the countries that have such facilities (MoH RS, 2008).

Incineration (burning) is appropriate for the elimination of the majority of medical wastes including some types of chemical wastes except radioactive wastes. During the incineration process of medical wastes, they are converted into gas (CO_2, NO_2, CO and other gases) and ashes (MoH RS, 2008). Incineration plants are any stationary or mobile technical units where waste is incinerated with or without recovery of the heat produced by combustion. In the incineration plants, high temperature oxidation of the waste and other thermal processes are conducted (SG, 2012a).

The goal of this paper is to propose a methodology for selection of efficient locations for medical wastes incineration plants. The paper is organized as follows. After introduction part, sections 2 and 3 refer to the

problems of potential locations and selection criteria. Section 4 gives theoretical background about DEA method. Section 5 illustrate the proposed methodology in the case of the Republic of Serbia.

2. SELECTION OF THE DISTRICT FOR INCINERATION PLANTS FOR MEDICAL WASTE

In terms of administrative and territorial division, the Republic of Serbia is divided into provinces, regions, administrative areas, the City of Belgrade, cities and municipalities. The Republic of Serbia has 30 administrative areas, 24 cities, 30 urban municipalities, 150 municipalities, 6,158 villages and 193 urban settlements (Statistical Office of the Republic of Serbia, 2015).

Table 1: Regions per number of cities, population, area, population density, number of cities/municipalities with more than 40.000 residents (Statistical Office of the Republic of Serbia, 2015) and number of health institutions (MoH RS, 2016).

Region	Number of cities	Population	Area km^2	Population density per 1 km^2	Number of cities/municip. with more than 40.000 res.	Number of health institutions
Vojvodina	6	1 659 440	21 614	89,4	13	92
Beograd	1	1 931 809	3 234	513,1	17	54
Šumadija & Western Serbia	10	2 031 697	26 493	76,7	14	101
South & Eastern Serbia	6	1 563 916	26 248	59,6	12	93
Kosovo & Metohija	1	-	10 910	-	-	-

Considering that the region Šumadija and Western Serbia takes the central place in the Republic of Serbia, has the most registered health institutions, largest area, population and most of the cities, as well as most of the cities/municipalities with more than 40.000 residents, it is chosen as the region where it is needed to determine efficient locations for medical waste treatment. Region Šumadija and the Western Serbia is divided into 8 districts, and has 14 cities/municipalities with more then 40.000 residents (Statistical Office of the Republic of Serbia). Those cities are considered separately as possible efficient locations for medical waste treatment.

3. SELECTION OF EFFICIENT LOCATIONS

As the long term objective of the Strategy of Waste Management is to ensure the capacity for burning (incineration) of organic industrial and medical waste, it is necessary to make a choice of efficient locations (SG, 2010b). First, it is necessary to determine the region within which it is still necessary to allocate potential locations, as input for further analysis and the criteria by which the efficient location will be determined. A schematic procedure for the selection of efficient locations is shown in the figure 1.

The criteria for determining efficient locations within the region are:

- The amount of generated medical waste that needs to be transported to the determined location - in order to eliminate the potential risk of spillage of the medical waste during its transportation. It is necessary to choose a location that requires the least amount of transport of medical waste. The amount of waste for the location contains the total waste generated in all of the cities gravitating to the given city as the center of medical waste collection in the area;
- The duration of the transport from all other locations to the given location - the location is necessary to occupy the best position in order to provide connections to other locations, requiring the shortest time of transport;
- Air pollution - the environment is one of the dimensions that must be taken into consideration in choosing efficient locations. Since incineration of medical waste involves the creation of certain gases such as CO_2, NO_2, CO and other gases, it is necessary to choose locations that have the least air pollution, specifically have the lowest risk of crossing the permissible limits of pollutants;
- The unemployment rate - as the waste incineration plant, from its construction and operation, requires certain trained staff, the location with the highest unemployment rate should be chosen, in order to achieve better economic effects;
- The safety from natural disasters - as a consequence of natural disasters, damage can be great to the plant and may represent a danger for environmental pollution, due to danger of medical waste. It is necessary to look for a location with the highest safety for the environment in the case of a natural disaster.

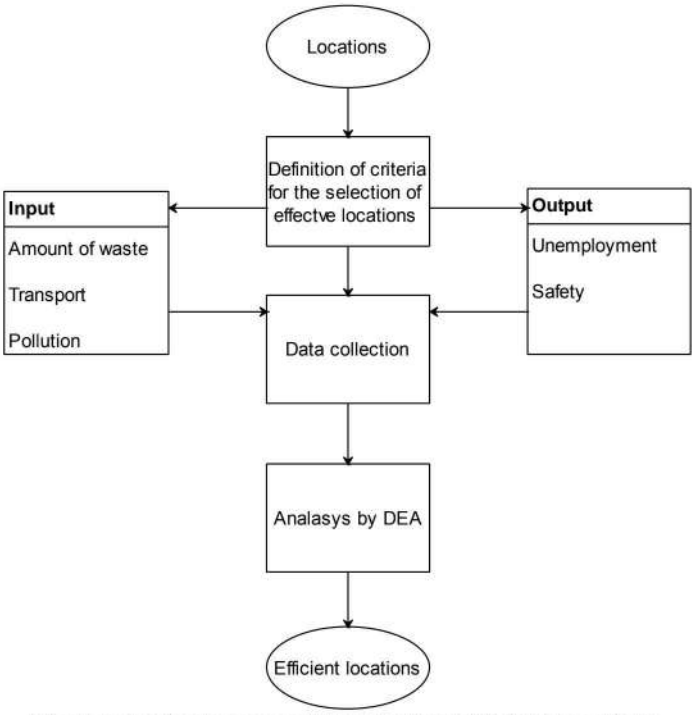


Figure 1: The process for selecting efficient locations

4. DEA

Data envelopment analysis (Charnes, Cooper, & Rhodes, 1978) was introduced for measuring relative efficiency of non-profit units, whose performance depends on multiple inputs and multiple outputs. These inputs and outputs are usually difficult to measure. Data envelopment analysis has lately received considerable attention in the construction of composite indicators. DEA can be defined as a linear programming technique used to find the optimal set of relative weights (u,v) that will give the highest possible efficiency ratio of outputs to inputs for the decision-making units (DMUs) being evaluated. Let us suppose that the following parameters are known:

n - number of DMUs

m - number of inputs

s - number of outputs

x_{ij} - known amount of i-th input of DMU$_j$ $(x_{ij} > 0, i = 1,2,...,m, j = 1,2,...,n)$,

y_{rj} –known amount of r-th output of DMU$_j$ $\left(y_{rj} > 0, r = 1,2,...,s, j = 1,2,...,n\right)$.

Having known parameters given above, Charnes, Cooper, and Rhodes (1978) formulated a mathematical model trying to maximize the relative efficiency h_k of DMU$_k$ (k=1,..,n) by optimizing weight of inputs v_i $(i = 1,...,m)$ and weight of outputs u_r $(r = 1,...,s)$. The calculation is more complicated if the model of fractional programming is used rather than the linear programming model. The linear model (1-4) and the dual linear program (5-8), corresponding to the model (1-4), are given below:

The linear model

$$(\max) h_k = \sum_{r=1}^{s} u_r y_{rk} \quad (1)$$

s.t.

$$\sum_{i=1}^{m} v_i x_{ik} = 1 \quad (2)$$

$$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \le 0, \quad j = 1, 2, ..., n \quad (3)$$

$$u_1,...,u_s \ge 0, v_1,...,v_m \ge 0 \quad (4)$$

Dual linear model

$$(\min) Z_k \quad (5)$$

s.t.

$$\sum_{j=1}^{n} \lambda_j y_{rj} \ge y_{rk}, \ r = 1,...,s \quad (6)$$

$$Z_k x_{ik} - \sum_{j=1}^{n} \lambda_j x_{ij} \ge 0, \ i = 1,...,m \quad (7)$$

$$\lambda_j \ge 0, \ j = 1,...,n \quad (8)$$

In the model (1-4), DMU maximizes the virtual output under the constraint that its virtual input is equal to 1. The constraint given by eq. (3) indicates that the optimal weights for the DMU_k must satisfy the condition that the virtual output of each of *n* DMUs cannot be greater than its virtual input. If the objective function is equal to 1, then virtual outputs of all inefficient DMUs will be less than the virtual inputs. If the value of the objective function is less than 1, the efficiency reference set for DMU_k can be constituted. It consists of DMUs with virtual output equal to virtual input and it forms frontier for measuring the level of efficiency. As already mentioned, virtual inputs $\sum_{i=1}^{m} v_i x_{ik}$ and virtual outputs $\sum_{r=1}^{s} u_r y_{rk}$ of DMU_k, are calculated as the sum of the product of known inputs x_{ik}, $i=1,...,m$ (outputs y_{rk}, $r=1,...,s$) and assigned weights, considered as variables in the model (1-4). The model (1-3) should be solved *n*-times, once for each DMU.

The objective function (5) shows the efficiency level of DMU_k. Its value is the same as an objective function value of primal model (1-4). Dual variables, λ_j, $(j=1,...,n)$ show the importance that is assigned to DMU_j ($j=1,...,n$), in defining the input-output mix of a hypothetical composite unit (efficiency reference set). The observed DMU_k is directly compared to a hypothetical composite unit. If DEA tries to minimize Z_k of DMU_k and it cannot find λ_j, $j=1,...,n$ multipliers that will generate an efficiency level below 1 (100%), DMU_k is evaluated as a relatively efficient unit (Z_k=1). In such case, λ_k is the only multiplier with a value greater than 0 ($\lambda_j = 0,\ j=1,...,n,\ j \neq k$).

In the DEA literature, a number of approaches have been proposed to introduce additional restrictions on the values that the multipliers can assume.

$$\alpha_i \leq \frac{v_i}{v_{i_o}} \leq \beta_i,\ i=1,...,m$$

$$\delta_r \leq \frac{\mu_r}{\mu_{r_o}} \leq \gamma_r, r=1,...,s$$

Here, v_{i_o} and μ_{r_o} represent multipliers which serve as "numeraires" in establishing the upper and lower bounds represented here by α_i, β_i and by β_r, γ_r for the multipliers associated with inputs *i*= 1, …, *m* and outputs *r* = 1, …, *s* where $\alpha_{i_0} = \beta_{i_o} = \delta_{r_o} = \gamma_{r_o} = 1$. The above constraints are called Assurance Region (AR) constraints as in Thompson et al. (1990).

5. CASE STUDY

The chosen region of Šumadija and Western Serbia has 14 potential locations for incineration plants. The DEA method was applied for the selection of efficient locations. The criteria defined in Section 3 are used as DEA inputs and outputs. Every location has three inputs: quantity of transported waste, transport time and pollution of the sites and two outputs: the unemployment rate and safety of the sites from natural disasters.

5.1. Amount of waste (x_{1j})

In Serbia, there is no precise data about the amounts of medical waste in the health care institutions. In order to determine the amount of medical waste generated in a particular location, we use estimated number of beds at each location. In the hospitals in Serbia, there are 15,000 beds (c_{bed}), with an average occupancy of 72% ($c_{occup.}$), while the assessment is that one bed generates 0.7 kg of waste per day ($c_{waste.bed.}$) (SG, 2010b). The number of beds were calculated based on total population 7,186,862 ($c_{popul.}$) and the number of residents in each location ($c_{popul.,j}$), which represents the total population of all the cities/municipalities in the field belonging to a given location (Statistical Office of the Republic of Serbia). Using the notation and equations given below, the amounts of waste that needs to be transported from other locations to the given location were calculated and shown in Table 5.

p_j – number of beds in the j-th location

w_j – amount of waste in the j-th location

$$p_j = c_{bed} \frac{c_{popul.,j}}{c_{popul}}$$

$$w_j = p_j \cdot c_{occup.} \cdot c_{waste.bed}$$

$$x_{1j} = \sum_{i \neq j, j=1}^{n} w_i$$

5.2. Transportation time (x_{2j})

Medical waste must be transported by specialized vehicles with a capacity of transport equal to the net weight of 80 kg of waste (Institute of Public Health of Serbia "Dr Milan Jovanovic Batut"). The time required for transport from one location to another is shown in the table 2 (Google Maps). Using the following equations, we get the values shown in Table 5.

Table 2: Time of transport in minutes

Location	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Užice (1)	0	100	160	163	81	58	159	173	164	132	99	167	134	117
Valjevo (2)	100	0	86	63	83	107	163	177	195	164	130	218	81	128
Loznica (3)	160	86	0	64	168	192	200	214	242	251	217	304	167	208
Šabac (4)	163	63	64	0	127	151	154	168	195	209	175	263	119	162
Gornji Milanovac (5)	81	83	168	127	0	29	98	113	116	85	51	139	57	53
Čačak (6)	58	107	192	151	29	0	106	120	108	77	43	125	80	63
Jagodina (7)	159	163	200	154	98	106	0	34	62	82	106	195	94	50
Paraćin (8)	173	177	214	168	113	120	34	0	45	71	104	182	105	60
Kruševac (9)	164	195	242	195	116	108	62	45	0	36	70	148	133	88
Trstenik (10)	132	164	251	209	85	77	82	71	36	0	38	132	126	70
Kraljevo (11)	99	130	217	175	51	43	106	104	70	38	0	101	107	59
Novi Pazar (12)	167	218	304	263	139	125	195	182	148	132	101	0	191	147
AranĐelovac (13)	134	81	167	119	57	80	94	105	133	126	107	191	0	60
Kragujevac (14)	117	128	208	162	53	63	50	60	88	70	59	147	60	0

z_j – the number of vehicles for the waste transport from j – th location

q – the capacity of vehicles

d_{jk} – the time required for transport from j – th to k – th location

$$z_j = \frac{\lceil w_j \rceil}{q}$$

$$x_{2j} = \sum_{j=1}^{n} z_j d_{jk}, k = 1, \ldots, n$$

5.3. Pollution (x_{3j})

Because of the lack of data about pollution at each location for each pollutant, the pollutants that we were observed are SO_2, NO_2 and CO. Emission of polluting substances by locations are shown in Table 3. Data marked with (i), (ii), (iii) and (iv) are taken from the Annual air quality report in the Republic of Serbia for 2014, 2013, 2012, 2011 (Ministry of Agriculture and Environmental Protection, 2014; 2013; 2012; 2011). Other data was evaluated by using available data about the emission of pollutants by one company and the number of companies at the appropriate location. The input data for this criterion is based on annual average emissions. Categories of air quality indicate whether the pollutant exceeds a limit value or reaches a tolerance value (Ministry of Agriculture and Environmental Protection, 2014). Air quality indicator for each pollutant was determined as percentage of the corresponding limit value. Then, maximal value of air quality indicator among all pollutant was assigned to each location, because they carry the highest risk of crossing the limit (threshold) values. Input data of pollution are shown in Table 5.

A – set of pollutants

g_{aj} – average annual emission of a-th pollutants in j-th location, $a \in A$

t_a – limit value for emission a-th pollutants in j-th location, $a \in A$

$$x_{3j} = \max_a \left(\frac{g_{aj}}{t_a} \right)$$

Table 3: The annual average emission of pollutants

Location	SO_2 µg/m^3	NO_2 µg/m^3	CO mg/m^3
Užice	6,50[i]	32,20[i]	1,65[i]
Valjevo	17,30[i]	21,70[i]	1,69[i]
Loznica	21,60[iii]	23,90[iv]	0,60[i]
Šabac	30,10[iii]	19,60[i]	1,35[i]
Gornji Milanovac	5,55	9,62	0,44
Čačak	8,10[i]	8,80[i]	1,27[i]
Jagodina	7,51	13,01	0,60
Paraćin	13,00[ii]	26,70[ii]	0,60[ii]
Kruševac	12,80[ii]	15,10[ii]	1,30[i]
Trstenik	5,23	9,05	0,42
Kraljevo	5,60[i]	35,10[iii]	0,50[iii]
Novi Pazar	6,21	10,75	0,49
AranĐelovac	5,55	9,62	0,44
Kragujevac	14,10[iii]	26,90[ii]	0,60[ii]
Limit value	50[i]	40[i]	3[i]

5.4. Unemployment (y_{1j})

The unemployment rate is the number of unemployed people ($c_{unemp..,j}$) as a percentage of the labour force ($c_{lab.force.,j}$) (Statistical Office of the Republic of Serbia). The value of this output is shown in Table 5. The equation used for calculating these values is following:

$$y_{1j} = \frac{c_{unemp.,j}}{c_{lab.force.,j}}$$

5.5. Safety (y_{2j})

Safety was observed as the probability that some natural disaster in observed location does not happen. The main natural disasters in Serbia are earthquakes, floods, landslides and forest fires. For the territory of each location, a number of risk points from certain natural disasters was determined by using the map of risk of natural disasters (Emergency management sector). The number of risk points is shown in the table 4.

Table 4. Number of risk points in the city / municipality

Location	Earthquakes	Floods	Landslides	Fires
Užice			6	2
Valjevo		2	2	3
Loznica	1	1		1
Šabac		2	1	1
Gornji Milanovac	1	1	1	2
Čačak		1	1	2
Jagodina		2	2	2
Paraćin				
Kruševac		4	2	
Trstenik	1		3	
Kraljevo		2	3	3
Novi Pazar		2	1	2
AranĐelovac		1		2
Kragujevac	1	1	1	2

The probability of occurrence of earthquakes, floods, landslides and fires are 0.0971, 0.7734, 0.0288 and 0.1007, respectively (e_b). These values were determined on the basis of the evidence for the territory of Europe (International Federation of Red Cross and Red Crescent Societies). Notation and equation for obtaining values for this output are given below, while the final values are shown in Table 5.

B – set of natural disasters

f_{bj} – number of risk points from b-th natural disasters in the j-th location

$$y_{2j} = 1 - \frac{\sum_{b}^{`} f_{bj} e_b}{\sum_{j=1}^{n} \sum_{b} f_{bj} e_b}$$

5.6. Result analysis

Based on previously presented calculations, the values of defined inputs and outputs are obtained (Table 5).

Table 5: The values of inputs and outputs

Location	Inputs			Outputs	
	Amount of waste	Transport time	Pollution	Unemployment	Safety
Užice	5017,73	9291	0,805	0,1894	0,9792
Valjevo	5339,86	9749	0,56333	0,1724	0,8939
Loznica	5486,32	14292	0,5975	0,3322	0,9459
Šabac	5337,43	11742	0,602	0,2126	0,9067
Gornji Milanovac	5713,94	7201	0,24044	0,1534	0,9387
Čačak	5358,02	7274	0,42333	0,1994	0,9441
Jagodina	5468,85	9260	0,3253	0,2634	0,8995
Paraćin	5597,55	9723	0,6675	0,2768	1,0000
Kruševac	5316,27	9829	0,43333	0,3006	0,8246
Trstenik	5671,17	9001	0,2263	0,2094	0,9898
Kraljevo	5401,67	7720	0,8775	0,2241	0,8922
Novi Pazar	5392,39	13514	0,26873	0,3687	0,9011
AranĐelovac	5644,52	8910	0,24044	0,2439	0,9457
Kragujevac	5195,4	7636	0,6725	0,2829	0,9387

DEA CCR model was solved without limit of weights and with (AR) limit of weight for the transport, which must be higher or equal to the weight for the amount of waste and pollution. The resulting efficiency and ranks of each location are shown in Table 6. In the first case seven efficient location were obtained (Užice, Gornji Milanovac, Čačak, Trstenik, Novi Pazar, AranĐelovac and Kragujevac), while in the second case three efficient locations were obtained (Gornji Milanovac, Čačak and Kragujevac). The minimum efficiency is 0.9012 (Valjevo) in the first and 0.7142 (Šabac) in the second case. Average efficiency for the first and second case is 0.9778 and 0.8849, respectively. In DEA CCR-AR model, we note that these limitations contribute significantly less to the average and the minimum efficiency, resulting that some locations have become inefficient or have significantly lower efficiency. Based on obtained results, Gornji Milanovac, Čačak and Kragujevac can be considered efficient locations for medical wastes incineration plants.

Table 6. Efficiency and ranks of each location

Location	CCR model		CCR- AR model	
	Efficiency	Rank	Efficiency	Rank
Užice	1	1	0,9156	5
Valjevo	0,9012	14	0,7926	12
Loznica	0,9901	9	0,7618	13
Šabac	0,917	13	0,7142	14
Gornji Milanovac	1	1	1	1
Čačak	1	1	1	1
Jagodina	0,9832	10	0,8331	11
Paraćin	0,9804	11	0,8871	8
Kruševac	0,9945	8	0,9000	7
Trstenik	1	1	0,9027	6
Kraljevo	0,9225	12	0,9185	4
Novi Pazar	1	1	0,8843	9
AranĐelovac	1	1	0,8792	10
Kragujevac	1	1	1	1

6. CONCLUSION

Improper disposal of medical waste carries great risks for the pollution of the environment. Therefore, the Republic of Serbia should focus on the issue of its treatment. Since current medical waste treatment is based on sterilization and fragmentation, then disposal in a landfill, or export, construction of incinerators is certainly

necessary. Locations in which possible adequate treatment of medical waste having incinerator is possible, should meet a variety of environmental, social, economic and technical criteria. In this paper, the quantity of waste, time of transport, pollution, unemployment and safety in case of natural disasters were observed as criteria for the selection of efficient locations. By using these criteria as DEA input and output, we have obtained efficient locations for the construction of such a plant. Analysis was performed in accordance to the CCR model, and CCR model with restrictions on weight. In the first case, the result indicates seven efficient locations, while the second case recommends three efficient locations. It is possible to perform further analysis in order to allocate one efficient location by solving optimal location problem or by application of super efficiency. A choice of efficient locations for incineration of medical waste can contribute to better management of medical waste in the territories of the Republic of Serbia.

REFERENCES

Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research, 2*(6), 429-444.

Google Maps. (n.d.). *https://www.google.rs/maps/dir///@43.618672,20.9571928,13z?hl=sr*. Retrieved February 2016, from https://www.google.rs/.

Institute of Public Health of Serbia "Dr Milan Jovanovic Batut". (n.d.). *Transport and treatment of infectious medical waste (in Serbian).* Retrieved March 2016, from http://www.batut.org.rs/.

International Federation of Red Cross and Red Crescent Societies. (n.d.). *World Disasters Report 2014.* Retrieved March 2016, from http://www.ifrc.org/Global/Documents/Secretariat/201410/WDR%202014.pdf.

Ministry of health of Republic of Serbia (MoH RS). (2008). *National guide for safe medical waste management (in Serbian).* Retrieved March 2016, from http://www.komorabiohemsrbije.org.rs/pdf/vodic_medicinski_otpad,.pdf.

Ministry of health of Republic of Serbia (MoH RS). (2016). *Register of medical institutions (in Serbian). http://www.zdravlje.gov.rs/showelement.php?id=8464*. Retrieved March 2016, from http://www.zdravlje.gov.rs.

Ministry of Agriculture and Environmental Protection. (2011). *Annual report of air quality in the Republic of Serbia in 2011 (in Serbian).* Retrieved March 2016, from http://www.sepa.gov.rs/download/VAZDUH2011.pdf.

Ministry of Agriculture and Environmental Protection. (2012). *Annual report of air quality in the Republic of Serbia in 2013 (in Serbian).* Retrieved March 2016, from http://www.sepa.gov.rs/download/VAZDUH2013.pdf.

Ministry of Agriculture and Environmental Protection. (2013). *Annual report of air quality in the Republic of Serbia in 2012 (in Serbian).* Retrieved March 2016, from http://www.sepa.gov.rs/download/VAZDUH2012.pdf.

Ministry of Agriculture and Environmental Protection. (2014). *Annual report of air quality in the Republic of Serbia in 2014 (in Serbian)*.Retrieved March 2016, from http://www.sepa.gov.rs/download/VAZDUH2014.pdf.

Statistical Office of the Republic of Serbia. (2015) *Statistical yearbook of the Republic of Serbia 2015 (in Serbian).* Retrieved March 2016, from http://webrzs.stat.gov.rs/WebSite/userFiles/file/Aktuelnosti/God2015.pdf

Statistical Office of the Republic of Serbia. (n.d.). *http://popis2011.stat.rs/?page_id=2162*. Retrieved February 5, 2016, from http://popis2011.stat.rs/.

Emergency management sector. (n.d.). *Map of the risk from natural disasters (in Serbian).* Retrieved March 2016,from http://prezentacije.mup.gov.rs/svs/HTML/karta%20rizika%20od%20elementarnih%20nepogoda.html.

SG (2012a). RS Official Gazette, Nos. 102/2010 and 50/2012. *The Regulation on the types of waste for which thermal treatment is carried out, the conditions and criteria for determing location, technical and technological conditions for design, demountable, equipping, and operation of the plant for thermal treatment of waste, the treatment of the rest after burning (in Serbian).* Retrieved March 2, 2016, from http://www.cis.org.rs/.

SG (2010b). RS Official Gazette, Nos. 29/2010. (n.d.). *Waste Management Strategy for the period 2010-2019. (in Serbian).* Retrieved February 2016, from http://www.pks.rs/.

SG (2010a). RS Official Gazette, Nos. 56/2010. (n.d.). *Rule book for categories, testing and classification of waste (in Serbian)* .Retrieved March 2016, from http://www.pks.rs/.

SG (2010c). RS Official Gazette, Nos. 78/2010. (n.d.). *Rule book for Medical Waste Management (in Serbian).* Retrieved February 7, 2016, from http://www.paragraf.rs/propisi/pravilnik_o_upravljanju_medicinskim_otpadom.html.

Thompson, R. G., Langemeir, L. N., Lee, C., Lee, E., & Thrall, R. M. (1990). The role of multiplier bounds in efficiency analysis with application to Kanssa farming. *Journal of Econometrics, 1*(2), 93–108.

SUSTAINABILITY OF THE FASHION INDUSTRY: HOW DOES THE YOUTH FEEL

Jelena Andreja Radaković*[1], Marko Pepić[1], Dejana Stevanović[2]
[1]University of Belgrade - Faculty of Organizational Sciences, Serbia
[2]University of Belgrade - Faculty of Transport and Traffic Engineering, Serbia
* Corresponding author, e-mail: jelena@festivalnauke.org

Abstract: *The 21st century is characterized by an ever-growing concern over environmental problems, which is present through all human life and activities. This results in "louder" and stronger demands from environmentally aware consumers for environmentally friendly and "green" products. Therefore, it is no wonder that the fashion industry had to abide to these demands, answering them with new concepts of sustainable or so-called "slow fashion", which as its result lowers the negative impact of fashion on the environment. Other than concepts of sustainable fashion, in this paper we showed the results of a research based on the case study of sustainability of the international fashion company H&M, and the youth's opinion and attitudes on the company's sustainability practices and the sustainability of the fashion industry as well. An analysis of the results was carried out using the SPSS 22 software package.*

Keywords*: sustainability, fashion industry, sustainable fashion, slow fashion, youth, H&M*

1. INTRODUCTION

The fashion industry has gone through a lot of changes, with the most significant ones in the last 20 years, when the boarders of the industry started shifting (Djelic & Ainamo, 1999). Since then, the changes in the dynamic of the fashion industry, such as the fading of the mass production, increased number of fashion seasons, as well as modified structural characteristics of the supply chain, drove the sellers to strive to reduce their costs and achieve the flexibility of design, quality, delivery and speed of entering the market (Doyle, Moore, & Morgan, 2006).

Today's fashion market is highly competitive and the constant need for new products caused the inevitable step by the manufacturers – increased number of seasons, i.e. higher frequency of coming out with new and "fresh" products. This implies a shorter life cycle and bigger sales profit (Sydney, 2008). In addition, the desire for variety and instant gratification of needs, with the knowledge of prices and the market by customers, has led customers to prefer brands such as Zara and H&M (National Post, 2009). Several studies have observed the various aspects of the relationship buyer-producer through "fast fashion", aspects such as the design of the garment in relation to the fast response of the manufacturers (Forza & Vinelli, 1996), the role of the supplier in the rapidly changing industry (Doyle, Moore, & Morgan, 2006), consumer behaviour (Bruce, & Daly, 2006) and financial performance (Hayes & Jones, 2006). However, it seems that there is discord in the literature concerning the concept of "fast fashion" among studies of this type of fashion, because only a few focused on the aspects that concern consumers and what actually steers those changes in the fashion industry (Barnes & Lea-Greenwood, 2006).

Innovations that occur at the intersection of the fashion and technology industries are amazing and transformative. In many cases, the fashion industry today resembles nothing like the one of a decade ago, and will change more in the next decade. One of rising trends in the fashion industry is certainly the rise of sustainable fashion. The fashion industry realizes we cannot continue this trend of polluting the planet, and has slowly started the road towards more sustainable fashion which includes a total rethink of how many clothes we really need in our closets, more recycling and reduction of the use of pollutants.

2. SUSTAINABILITY AND FASHION INDUSTRY

"Second to oil, fashion and textiles is the most polluting industry in the world. Every stage in a garment's life threatens our planet and its resources. It can take more than 20,000 liters of water to produce 1kg of cotton, equivalent to a single t-shirt and pair of jeans. Up to 8,000 different chemicals are used to turn raw materials into clothes, including a range of dyeing and finishing processes." (BOF, 2016)

On the other hand, "over the past decade, sustainability and ethical conduct have begun to matter in fashion (Emberley, 1998; Moisander & Personen, 2002); companies have realized that affordable and trend-sensitive fashion, while typically highly profitable, also raises ethical issues" (Aspers & Skov, 2006; Joy, Sherry Jr, Venkatesh, Wang & Chan, 2012). Sustainability represents a primary issue of the 21st century and is often in relation to corporate social responsibility (Aguilera, Rupp, Williams, & Ganapathi, 2007).

When it comes to sustainability, it should be noted that there is no single accepted definition, although this term is usually associated with the following three interpretations:

- Sustainability refers to those activities that can last endlessly without casein damage to the environment (Fletcher, 2008).
- Sustainability presents not doing to others what we do not want done to us (Partridge, 2011).
- Sustainability presents satisfying the needs of present generations without comprising the future generations' abilities to satisfy their needs (WCED, 1987).

None the less, the most comprehensive definition was the one by (2007): "Sustainability is about much more than our relationship with the environment; it's about our relationship with ourselves, our communities, and our institutions."

We can conclude that sustainable fashion, supports living harmoniously with nature, employs trained artisans in safe and humane working conditions (Partridge, 2011). Also, sustainable fashion "demands a new way of thinking, which involves slowing down fashion cycles, understanding why and how a garment is made, seeking workable solutions in an era of urgency and crisis and redefine our scholarly approach to issues related to dress, body, and culture" (Root, 2009).

Considering all the above, it can be concluded that "fast fashion" is by no means sustainable since it is distinguished by cheap materials that have a harmful impact on the environment, as well as very short life cycle of its products, which quickly leads to the stage of waste if not recycled. Therefore, many authors are calling sustainable fashion – "slow fashion" (Clark, 2009; Fletcher, 2008; Patel & Davidson, 2003; Patel & Tebelius, 1987; Tran, 2008), as a logical name that is the opposite of fast fashion, bearing in mind that "slow fashion" is characterized by sustainable production and consumption, eco design, waste management, recycling and reusing, connected with quality, environmental awareness and balance, as well as something durable and made from recycled or organic materials (Holt, 2009). The issues of "slow fashion" are making garments that last longer in such material and style with the philosophy: less, but of the best. That is how "slow fashion" perfectly coincides with the concept of sustainable consumption.

3. THE RESEARCH

In order to provide a highlight of sustainability in the fashion industry, which became the main problem of this industry in the previous couple of years, partly thanks to Andrew Morgan's documentary "The True Cost" and the launch of the H&M Conscious program and the recycling program, the poster will feature the case study of the company H&M. The showed case study is dealing with the practices of sustainability of this company, as well is its contribution to the Sustainability Report 2014 (H&M, 2016a; H&M, 2016b).

3.1. Methodology

In order to provide an overview of how much the younger generation exactly is familiar with the sustainability of fashion, and whether it is important to them, the authors of the paper surveyed their colleagues from the University of Belgrade – Faculty of Organizational Sciences, Serbia on their attitudes on the sustainability of the fashion industry. An analysis of the results was carried out using the SPSS 22 software package. This research featured 321 participants (out of which 206 participants were female and 115 were male).

3.2. Results

Turning fashion into a more sustainable industry "remains an uphill battle, with plenty of technological, systematic, and business struggles to overcome" (Vogue, 2016). At Glasgow Caledonian University, New York, Simon Collins, former dean of the Fashion School at Parson's New School for Design, and Julie Gilhart, respected freelance fashion consultant, discussed some of these issues in their second "Fashion Garage" event conversation, giving free advice to young designers, with the focus of the most recent one being on making the production more environmentally friendly:

1. The product should always come first.
2. Use social media to your benefit.
3. Accept that consumer shopping habits won't change.
4. Focus on materials.
5. Vote with your wallet.

Having in mind all of this, the sustainable organization of H&M and their road to sustainability is commendable, and is characterized by (H&M, 2016b):

- *Conscious materials for a more sustainable fashion future* – the use of organic natural and recycled materials.
- *Cotton* – organic and recycled cotton. The company H&M is one of the leading users of organic cotton in the world.
- *Water* – promotion of responsible use of water along the product's lifecycle, from how cotton farmers water their crops, to how customers wash their clothes. The World Economic Forum states the water crisis as the risk with the biggest global impact. The H&M's partnership with WWF is ground-breaking – the water stewardship strategy goes far beyond the factory lines.
- *A fair living wage to garment workers* – responsible partners, working conditions, commitments, protecting childhood.
- *Animal welfare* – improving of the animal welfare in the supply chain, from involvement to education and training of suppliers and farmers.
- *Less use of planet's resources.*
- *Garment collecting* - changing the way of make, use and dispose of clothes. Of the thousands of tonnes of textiles that people throw away every year, as much as 95% could be re-worn or recycled.
- *Business concept* - fashion and quality at the best price in a sustainable way.

In order to evaluate the familiarity of the participants with the sustainability practices and actions, after a set of general questions, the following questions the participants marked on a rating scale from 1 to 5, based on the truthfulness of the statement, and we calculated the percentage of them that answered positively to these questions either with a 4 (I agree) or a 5 (I absolutely agree). The results based on the answers given by participants to our eight questions are shown in the Table 1.

Table 1: The results on the poll, featuring the questions on sustainability of the fashion industry

Question	Participants with positive attitudes toward sustainability in the fashion industry [%]
1. "When I buy clothes, I think of the way it was manufactured"	33.4
2. "If I knew that the workers that made the garment were treated poorly, it would make me rethink of buying the product"	96.7
3. "I believe that the fashion industry pollutes the environment"	86.4
4. "If I knew that the company was environmentally friendly, I would feel better about buying the product even if it was more expensive"	64.5
5. "I own clothes labelled as environmentally friendly"	46.7
6. "I know that H&M is environmentally friendly"	89.8
7. "I have participated in the H&M recycling program"	24.3
8. "I believe that the sustainability of the fashion industry is important"	93.4

4. DISCUSSION AND CONCLUSION

Having in mind that 2 billions of poisonous pesticides are used each year for farming the cotton meant for the textile industry – more than for any other agriculture crop and the fact that textile industry uses more water than any other branch of industry (except agriculture), and the amount of pesticides that get released into the

air during the production of the cotton necessary for the textile industry each year represents 16 percent of the total global amount of insecticides, for these reasons, we can see the importance of good sustainable practices of the company and brand H&M i.e. Hennes&Mauritz, which showed that you can have both a profitable business and a sustainable one with these following "green consequences":

- Better for the Earth.
- Better for people.
- Better for animals.
- Lasts longer.
- Easier and cheaper.
- Organic.

The results gained from our research show that even though at the first moment, the unaware youth does not think of the consequences and the background of the items they shop for (only 33.4 percent of the younger generation thinks about the way a garment was manufactured), as soon as the implications of their actions are brought to their attention, it is easy to change their mind (96.7 percent claims that if they knew that the workers were treated poorly it would make them rethink the purchase).

In addition, the participants showed that sustainability and environmentally friendly aspect of the manufacturing process does play a role in their shopping, as long as the price is still in their price range (64.5 percent of the participants said that if they knew that the product is environmentally friendly they would buy it even if it was more expensive).

Also, from our research, we can clearly see that the marketing campaign and the advertisement of a sustainable organization and its sustainability actions is very important, and that a good example of a this is precisely the one followed by H&M, because 89.8 percent of the participants of this research said that they are aware of the fact that this company is environmentally friendly.

However, our research has showed that this campaign still has to be worked on further because only a small number of students surveyed (24.3 percent) has actually participated in the H&M recycling program, while only 46.7 percent of the students owns environmentally friendly clothes.

Lastly one of the main goals of this research was to show that the younger buyers do care about sustainability of the fashion industry, and in that we have succeeded – 93.4 percent of the participants agree.

Fashion itself, shoes, dresses, suits and skirts, may seem irrelevant when compared to the real problems mankind is facing everyday in the 21st century such as: climate change, nuclear catastrophes, wars, poverty, and lack of drinkable water, disease and hunger. But when we take in concern the fact that the fashion industry around the world employs millions of people (from the fashion company workers, to models, photographers, journalists and retail store clerks), and that fashion is an unavoidable part of our everyday lives, ignoring the social and environmental impact of this industry would be very negligible on our part.

REFERENCES

Aguilera, R.V., Rupp, D.E., Williams, C.A., & Ganapathi, J. (2007). Putting the S Back in Corporate Social Responsibility: A Multi-level Theory of Social Change in Organizations. *Academy of Management Review*, *32*(3), 836-63.

Aspers, P., & Skov. L. (2006). Encounters in the Global Fashion Business. *Current Sociology*, *54*, 745-63.

Barnes, L., & Lea-Greenwood, L. (2006). Fast fashioning the supply chain: Shaping the research agenda. *Journal of Fashion Marketing and Management*, *10*(3), 259-271.

Bruce, G., & Daly, L. (2006). Buyer behaviour for fast fashion. *Journal of Fashion Marketing and Management*, *10*(3), 329-344.

Clark, H. (2009). Slow Fashion - An Oxymoron or a Promise for the Future? *Fashion Theory, 12*(4), 427-446.

Djelic, M.L., & Ainamo, A. (1999). The co evolution of new organizational forms in the fashion industry: A historical and comparative study of France, Italy, and the United States. *Organizational Science*, *10*(5), 622-637.

Doyle, S.A., Moore, C.M., & Morgan, L. (2006). Supplier management in fast moving fashion retailing. *Journal of Fashion Marketing and Management*, *10*(3), 272-281.

Emberley, V. (1998). *Venus and Furs: The Cultural Politics of Fur*. London: I. B. Tauris & Co.

Fletcher, K. (2008). *Sustainable Fashion & Textiles: Design Journeys*. Oxford: Earthscan.

Forza, C., & Vinelli, A. (1996). An analytical scheme for the change of the apparel design process towards quick response. *Int. J. Clothing Sci. Technol.*, *8*(4), 28-43.

H&M. (2016a). *Sustainability*. Retrieved from http://about.hm.com/en/About/sustainability.html.

H&M. (2016b). *Sustainability Report 2014*. Retrieved from http://sustainability.hm.com/content/dam/hm/about/documents/masterlanguage/CSR/reports/Conscious%20Actions%20Sustainability%20Report%202014.pdf.
Hayes, S.G., & Jones, N. (2006). Fast fashion: A financial snapshot. *Journal of Fashion Marketing and Management*, *10*(3), 282-300.
Holt, T. (2009). *Is the time right for Slow Fashion?* Retrieved from http://www.csmonitor.com/The5 Culture/2009/0210/p17s015lign.html/(page)/2.
Joy, A., Sherry Jr, J.F., Venkatesh, A., Wang, J., & Chan, R. (2012). Fast fashion, sustainability, and the ethical appeal of luxury brands. *Fashion Theory*, *16*(3), 273-295.
Moisander, J. & Personen, S. (2002). Narratives of Sustainable Ways of Living: Constructing the Self and Others as a Green Consumer. *Management Decision*, *40*(4), 329-42.
National Post. (2009). *Fast fashion*. Retrieved from http://trendwatching.com/about/inmedia/articles/2009_fast_fashion.html.
Partridge, D.J. (2011). Activist Capitalism and Supply Chain Citizenship: Producing Ethical Regimes and Ready-to-Wear Clothes. *Current Anthropology*, *52*(S3), S97-S111.
Patel, R., & Davidson, B. (2003). *Forskningsmetodikens grunder, att planera, genomföra och rapportera en undersökning*. Lund: Studentlitteratur.
Patel, R., & Tebelius, U. (1987*). Grundbok i forskningsmetodik*. Lund: Studentlitteratur.
Root, R. (2009). Eco-Chic: The Fashion Paradox by Sandy Black. *Fashion Practice*, *1*(2), 267-270.
Seidman, D. (2007). *How We Do Anything Means Everything*. Hoboken, NJ: John Wiley & Sons.
Sydney. (2008). *Fast fashion is not a trend*. Retrieved from http://www.sydneylovesfashion.com/2008/12/fast-fashion-is-trend.html.
The Business of Fashion – BOF. (2016). *How can the fashion industry become more sustainable?* Retrieved from http://www.businessoffashion.com/community/voices/discussions/can-fashion-industry-become-sustainable.
Tran, K.T.L. (2008). Slow Ride. *Women's Wear Daily*, *vol.195*, 74.
Vogue. (2016). *Save the Fashion Industry, Save the World! How We Can Make a Greener Future*. Retrieved from http://www.vogue.com/13366681/sustainability-in-fashion-tips-julie-gilhart-simon-collins/.
World Commission on Environment and Development – WCED. (1987). *Our Common Future*. London: Oxford Paperbacks.

THE ATTITUDES OF ENVIRONMENTALLY EDUCATED STUDENTS ABOUT A NEW GLOBAL DEVELOPMENT AGENDA

Jasna Petković*[1], Jelena Andreja Radaković[1]

[1]University of Belgrade - Faculty of Organizational Sciences, Serbia
* Corresponding author, e-mail: petkovic.jasna@fon.bg.ac.rs

Abstract: *The aim of this paper is to shine light on the attitudes of environmentally educated postgraduate students about a new development agenda – 2030 agenda for sustainable development, and its 17 urgent goals. In order to evaluate postgraduate students' attitudes the authors used the Delphi method. The usage of the Delphi method is suggested having in mind that a lot of authors agree that this method has high applicability for sustainability foresight, as well having in mind the fact that it is one of the best-known qualitative methods of forecasting in the long run, especially when quantitative methods are not adequate, as it happened in this case.*

Keywords*: environmentally educated students, a new global development agenda, postgraduate students' attitudes, delphi method*

1. INTRODUCTION

Today, the environmental education represents a necessary education to shape a sustainable future. This means that the environmental education must include key sustainable development issues into the curriculum of the subject, with clear goals in order to motivate the student not only to learn, but to change their attitudes, behaviour and take environmental actions for sustainable development (UNESCO, 2016).

In light of the above, the authors of the paper chose to do their research on how environmentally educated students value goals of a new global development agenda.

For the panel group the authors chose postgraduate students enrolled at the Management of Environmental Protection course at the University of Ljubljana – Faculty of Administration, the Republic of Slovenia. For the purpose of this research the authors used the Delphi method for measuring students' attitudes about 17 sustainable development goals of a new global development agenda – 2030 Agenda for Sustainable Development.

2. A NEW GLOBAL DEVELOPMENT AGENDA – THE 2030 AGENDA FOR SUSTAINABLE DEVELOPMENT

Sustainable development (SD) has been discussed extensively in the theoretical literature since the concept was adopted as an overarching goal of economic and social development by UN agencies, by the Agenda 21 nations, and by many local governments and private-sector actors (WCED, 1987). The literature includes many alternative theoretical and applied definitions of sustainable development. The theoretical work spans hundreds of studies that are based on economic theory, complex systems approaches, ecological science and other approaches that derive conditions for how development paths can meet SD criteria (IPCC, 2007).

Several definitions have been presented to describe the principle of sustainable development; the most frequently quoted being the one presented in the Brundtland Report (Brundtland, 1987). According to this report sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". It contains within it two key concepts:

- the concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given; and
- the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.

More operational principles of sustainability were presented by the former Chief Economist for the World Bank, Herman E. Daly. These principles are known as Daly's rules and they define the condition of ecological sustainability:

- renewable resources such as fish, soil, and groundwater must be used no faster than the rate at which they regenerate;

- non-renewable resources such as minerals and fossil fuels must be used no faster than renewable substitutes for them can be put into place; and
- pollution and wastes must be emitted no faster than natural systems can absorb them, recycle them, or render them harmless (Smith, 2010).

The General Assembly of the United Nations adopted the new resolution on 25th September of 2015. This resolution is a new sustainable development agenda for the period of 2015-2030: Transforming our world: the 2030 Agenda for Sustainable Development: "The 17 Sustainable Development Goals and 169 targets which we are announcing today demonstrate the scale and ambition of this new universal Agenda. They seek to build on the Millennium Development Goals and complete what they did not achieve. They seek to realize the human rights of all and to achieve gender equality and the empowerment of all women and girls. They are integrated and indivisible and balance the three dimensions of sustainable development: the economic, social and environmental." (UN, 2015)

The 17 Sustainable development goals are (UN, 2015):

- Goal 1: End poverty in all its forms everywhere.
- Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
- Goal 3: Ensure healthy lives and promote well-being for all at all ages.
- Goal 4: Ensure inclusive and quality education for all and promote lifelong learning.
- Goal 5: Achieve gender equality and empower all women and girls.
- Goal 6: Ensure access to water and sanitation for all.
- Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all.
- Goal 8: Promote inclusive and sustainable economic growth, employment and decent work for all.
- Goal 9: Build resilient infrastructure, promote sustainable industrialization and foster innovation.
- Goal 10: Reduce inequality within and among countries.
- Goal 11: Make cities inclusive, safe, resilient and sustainable.
- Goal 12: Ensure sustainable consumption and production patterns.
- Goal 13: Take urgent action to combat climate change and its impacts.
- Goal 14: Conserve and sustainably use the oceans, seas and marine resources.
- Goal 15: Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss.
- Goal 16: Promote just, peaceful and inclusive societies.
- Goal 17: Revitalize the global partnership for sustainable development.

3. DELPHI METHOD

Technology forecasting in developed countries is a process focused on recognizing critical generic technologies, and most likely it will exert great influence on economic, environmental, and social development in general. However, for underdeveloped and developing countries, the role of technology forecasting is of great importance for identifying technology niches – technology domains in which it is possible to accomplish a competitive position on the world market (Albright, 2002). Technology forecasting began to play an important role in companies' strategic planning, as well as in their race for comparative advantage. Technology forecasts use different methods among which is the Delphi method that presents one of the most widespread methods for intuitive forecasting.

Delphi method is the most commonly known forecasting method that is based on series of written questionnaires with feedback and re-voting (Popper, 2008). There are two participant roles: the design group (sometimes just one person) that makes the questionnaires and the consensus of the expert group, and the expert group – a panel that answers the questionnaires. The members of the panel do not meet face-to-face; they are characterized by three important conditions: anonymity, iteration with controlled feedback, and statistical response. This is not an opinion survey, but rather, a way of systematically finding out and summarizing expert judgment in successive rounds of the Delphi forecasts (Mullen, 2003).

Despite some limitations, it has been recommended that studies employing the Delphi should be continued in order to further refine the technique and to explore its application. The first idea for applying the Delphi method in forecasting events in education came from the article "The Delphi Technique: A Possible Tool for Predicting Future Events in Nursing Education" by Bramwell L. and Hykawy E. in which the authors have presented the potential use of the Delphi method in this area (Bramwell & Hykawy, 1999). Despite the limitations they indicated, one suggestion supported by the panellist in the study was important, which is of special interest for the society in transition. They have suggested that the Delphi method seemed to have

promising application as a tool for teaching people to think and discuss about the future in a more complex way than they ordinarily would.

The Delphi method is one of the best-known qualitative methods of forecasting in the long run, especially when quantitative methods are not adequate. It is applied for forecasting the probability and time of the emergence of future events. In order to give a prognosis, a group of experts identifies and defines the given event, the probability of its development and possible time of future event. Delphi method is also important because of the impartiality of participants bearing in mind that opinions and presumptions of forecasting experts are based on collecting data through polls, i.e. on filling out the questionnaires. Experts fill out questionnaires independently of each other, which gives this method the impartial character when it comes to judgment (Makridakis, Wheelwright, Hyndman, & 1998).

The Delphi method is an attractive method for graduate students completing masters and PhD level research. It is a flexible research technique that has been successfully used in our paper to explain Postgraduate Students' Attitudes about Sustainable Development Goals. Delphi studies have been useful in educational settings in forming guidelines, standards, and in predicting trends (Skulmoski & Hartman, 2007). The Delphi method works especially well when the goal is to improve our understanding of problems, opportunities, solutions, or to develop forecasts.

Delphi studies have been useful in educational settings in forming guidelines, standards, and in predicting trends. The Delphi Technique will be useful for educators in developing curricula and learning experiences to prepare our students for future careers. Delphi studies are extremely useful for collecting data from students and alumni regarding the curriculum, and information science trends, and funding (Green, 2014).

4. POSTGRADUATE STUDENTS' ATTITUDES ABOUT SUSTAINABLE DEVELOPMENT GOALS – A CASE STUDY

For our research we chose the students of the University of Ljubljana – Faculty of Administration, which have in the November of 2014/2015 school year attended the course Management of Environmental Protection, and which joined the research only when they have successfully finished the course.

At this course, a framework and a curriculum for good environmental higher education are developed on a wide scale of scientific and practical knowledge of environmental science and sustainable development as a good benchmark for the adequate improvement of students' knowledge at postgraduate level, as well as a promotion of higher order thinking skills in a cooperative context for learning and evaluation (Petrovic et al., 2014). Having this in mind, the curriculum of this subject accents the following topics: the resources of the Earth, particularly soil, water, minerals, etc., the implications of the resource distribution in determining the nature of societies and the rate and character of economic development, the role of science and technology in the development of societies and the impact of these technologies on environment, cooperative international and national efforts to find solutions to common global issues, and to implement strategies for a more sustainable future, processes of planning, policy-making and action for sustainability by governments, businesses, non-governmental organizations and the public (NAAEE, 1996; Petrović, 2012; FOS, 2016).

4.1. Methodology

In this paper, we discussed the application of the Delphi method in evaluation of postgraduate students' attitudes about 17 sustainable development goals of a new global development agenda by using a five point scale (1 – *the most significant*, 2 – *very significant*, 3 – *significant*, 4 – *not so significant*, 5 – *the least significant/insignificant*).

We suggested the use of the Delphi method, having in mind that Bramwell and Hykawy (1999) have suggested that the Delphi method seemed to have promising application as a tool for teaching people to think and discuss about the future in a more complex way than they ordinarily would. It can be concluded that this method has high applicability for sustainability foresight, as well as it is one of the best-known qualitative methods of forecasting in the long run, especially when quantitative methods are not adequate, as it happened in this case.

4.2. Instruments

In order to evaluate the results of the questionnaire, we used statistical analysis for calculation of the arithmetic mean rating, variance and standard deviation:

- Calculation of the arithmetic mean rating ($t_n^{)}$ was made using the following equation :

$$t_n = \frac{1}{n}\sum_{i=1}^{k} f_i \cdot t_i \quad (1)$$

where k is the number of different rating scores, f_i is a number of experts that evaluated observed item with rating score t_i, and n represents the total number of experts ($n = \sum_{i=1}^{k} f_i$).

- Calculation the variance and standard deviation were made using the following equations:

$$\sigma^2 = \frac{1}{n}\sum_{i=1}^{k} f_i t_i^{\,2} - t_n^{\,2} \quad (2)$$

$$\sigma_n = \sqrt{\sigma_n^2} \quad (3)$$

where σ_n^2 is variance and σ_n is standard deviation.

5. RESULTS AND DISCUSSION

After calculating the results of students from the first questionnaire, arithmetic mean and variance were calculated. Summarized results of the first questionnaire are given in Table 1. As a significant agreement in responses has been detected, the second round of questioning was not necessary.

Table 1: The results of the first questionnaire

No.	Sustainable development goals	Arithmetic mean (t_n)	Variance (σ^2_n)
1.	End poverty in all its forms everywhere	1.47	0.77
2.	End hunger, achieve food security and improved nutrition and promote sustainable agriculture	1.13	0.25
3.	Ensure healthy lives and promote well-being for all at all ages	1.6	0.91
4.	Ensure inclusive and quality education for all and promote lifelong learning	1.93	0.61
5.	Achieve gender equality and empower all women and girls	2.13	0.79
6.	Ensure access to water and sanitation for all	1.13	0.12
7.	Ensure access to affordable, reliable, sustainable and modern energy for all	1.67	0.48
8.	Promote inclusive and sustainable economic growth, employment and decent work for all	1.67	0.48
9.	Build resilient infrastructure, promote sustainable industrialization and foster innovation	2.33	0.90
10.	Reduce inequality within and among countries	2.20	0.96
11.	Make cities inclusive, safe, resilient and sustainable	2	0.67
12.	Ensure sustainable consumption and production patterns	2.27	0.58
13.	Take urgent action to combat climate change and its impacts	1.87	0.50
14.	Conserve and sustainably use the oceans, seas and marine resources	1.67	0.48

15.	Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss	1.73	0.60
16.	Promote just, peaceful and inclusive societies	2.13	0.53
17.	Revitalize the global partnership for sustainable development	2.27	0.58

Based on the responses gathered, we can conclude that, in the opinion of the respondents, the most important goals of sustainable development are to:

1. Ensure access to water and sanitation for all – with the arithmetic mean of 1.13, and variance of 0.12 which is more than a good mark and shows a fair compliance when it comes to the students' attitude.
2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture – with the arithmetic mean of 1.13, and variance of 0.25 which again shows the same complient attitudes as before.
3. The third place "share" the following goals - to ensure access to affordable, reliable, sustainable and modern energy for all and to promote inclusive and sustainable economic growth, employment and decent work for all and to conserve and sustainably use the oceans, seas and marine resources – with their arithmetic mean being 1.67, their variance 0.48, which are excelent marks and present a fair compliance between the students.

6. CONCLUSION

The key aim of the research presented in this paper has been to provide an idea of implementing the Delphi method in evaluating environmentally educated postgraduate students' attitudes about a new global development agenda and sustainable development goals, and proving that the Delphi method could be a good tool for the measurement of environmental education and the education for sustainable development achievements as well.

Gained results from our research pointed out that this kind of use of the Delphi method can provide good results having in mind that the results gathered, not only show a compliance in the students' responses, which speaks of the good background knowledge they gained during their studies at the course of Management of Environmental Protection, but also that the Delphi method can be used for further analysis of the reasons behind their assigning high marks to specific goals of sustainable development, which depicts the image of the students' attitudes towards these goals.

A more in depth analysis of these results demands a larger number of respondents, and not students from only one university, but instead conducting a broader and more detailed research, which should be a possible direction of future research, especially when having in mind that "a basic premise of education for sustainability is that just as there is a wholeness and interdependence to life in all its forms, so must there be a unity and wholeness to efforts to understand it and ensure its continuation" (UNESCO, 2012).

REFERENCES

Albright, R. (2002). What can past technology forecast tell us about the future*, Technological Forecasting and Social Change*, *69*, 443-464.

Bramwell, L., & Hykawy, E. (1999). The perception of community nurses, administrators, and educators, *Journal of Advanced Nursing*, *24*, 1224-1233.

Brundtland (1987). *Our Common Future/Brundtland Report*. United Nations World Commission on Environment and Development.

Green, R. (2014). The Delphi Technique in Educational Research.

IPCC – The Intergovernmental Panel on Climate Change (2007). *Fourth Assessment Report: Climate Change*. Retrieved from https://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4_wg2_full_report.pdf.

Makridakis, S., Wheelwright, S.C., & Hyndman, R.J. (1998.). *Forecasting Methods and Applications*. New York: Willey.

Mullen, P. (2003). Delphi: myths and reality. *Journal of Health Organization and Management*, *17*(1), 37-52.

North American Association for Environmental Education - NAAEE (1996). *Environmental Education Materials: Guidelines for Excellence*. Rock Spring, GA: NAAEE.

Petrovic, N., Jeremic, V., Petrovic, D., & Cirovic, M. (2014). Modeling the Use of Facebook in Environmental Higher Education. In Ġ. Mallia (Ed.), *The Social Classroom: Integrating Social Network Use in Education,* 100-119.

Smith, J.R. (2010). *Floor Drains with Adjustable Strainer Heads*. Retrieved from http://www.jrsmith.com/product.aspx?ProductId=159&title=Floor+Drains+with+Adjustable+Strainer+Heads.

Popper, R. (2008). How are foresight methods selected? *Foresight, 10*(6).

Skulmoski, J.G., & Hartman, T.F. (2007). *Journal of Information Technology Education, Volume 6*.

United Nations – UN. (2015). *Transforming our world: the 2030 Agenda for Sustainable Development*. Retrieved from http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E.

Petrović, N. (2012). *Ekološki menadžment*. Beograd: Fakultet organizacionih nauka.

Faculty of Organizational Sciences – FOS (2016). Master Studies – Management – Curriculum. Retrieved from http://www.fon.bg.ac.rs/downloads/2014/04/Knjiga-predmeta.pdf. (In Serbian)

United Nations Organization for Education, Science and Culture - UNESCO (2012). *Education for sustainable development*. Retrieved from http://www.unesco.org/new/en/education/themes/leading-the-international-agenda/education-for-sustainable-development/education-for-sustainable-development/.

United Nations Organization for Education, Science and Culture - UNESCO (2016). *Education for Sustainable Development (ESD)*. Retrieved from http://www.unesco.org/new/en/education/themes/leading-the-international-agenda/education-for-sustainable-development/.

WCED – World Commission on Environment and Development (1987). *Our Common Future*. Oxford: Oxford University Press.

FINANCIAL MANAGEMENT 597

INTEGRATION AND REGIONAL POSITION OF STOCK MARKETS: A CASE OF SOUTH EAST EUROPEAN COUNTRIES 598
Radovanov Boris, Marcikić Aleksandra

IMPACT OF THE EFFICIENCY OF THE TAX ADMINISTRATION ON THE MACROECONOMIC STABILITY 604
Savić Gordana, Dragojlovic Aleksandar

PROGRAM BUDGETING OF LOCAL AUTHORITIES IN SERBIA – A TOOL FOR CITIZEN PARTICIPATION AND SUSTAINABLE DEVELOPMENT 611
Jovanović Vladimir, Knežević Snežana

HAS THE FINANCIAL CRISIS CHANGED THE RESEARCH AGENDA ON BANKING REGULATION AND SUPERVISION? 617
Dias Lopes Jose

AN APPLICATION OF NEURAL NETWORKS AND FUNDAMENTAL ANALYSIS FOR AUTOMATED TRADING: BELGRADE STOCK EXCHANGE CASE 626
Rakićević Aleksandar, Milovanović Ana, Aničić Rastko

PERFORMANCE OF EVENT-DRIVEN HEDGE FUNDS' STRATEGIES 635
Bogojevic Arsic Vesna

USING FINANCIAL STATEMENT DATA TO EXPLAIN STOCK PRICE MOVEMENTS – BELGRADE STOCK EXCHANGE CASE 644
Milovanovic Jovan, Mesic Teodora, Rakicevic Aleksandar

APPLYING A NEURO FUZZY SYSTEM FOR CREDIT RISK EVALUATION 650
Vranić Nevena, Đurić Javorka, Dragović Ivana

OPTIMIZATION OF ATM CASH MANAGEMENT 658
Milosevic Nela, Makajic Nikolic Dragana, Barjaktarovic Rakocevic Sladjana

DRIVERS OF HOTEL PROFIT MARGINS: A STUDY OF THE BELGRADE HOTEL SECTOR 665
Milosavljević Miloš, Milanović Nemanja, Benković Slađana

PROTECTION OF INTELLECTUAL PROPERTY RIGHTS - WHAT DO FINANCIAL REPORTS SAY? 673
Radovanovic Nikola, Dmitrovic Veljko, Knezevic Snezana

THE IMPORTANCE AND APPLICATION OF TRANSFER PRICING COMPLIANCE IN MODERN BUSINESS 678
Djurica Maja, Jovanovic Marko, Maric Miha

FINANCIAL MANAGEMENT

INTEGRATION AND REGIONAL POSITION OF STOCK MARKETS: A CASE OF SOUTH EAST EUROPEAN COUNTRIES

Boris Radovanov*[1], Aleksandra Marcikić[1]
[1]University of Novi Sad, Faculty of Economics Subotica
*Corresponding author, e-mail: radovanovb@ef.uns.ac.rs

Abstract: *The study examines short and long run dynamics in the relationships between six emerging South East European stock markets applying a Markov Switching Vector Error Correction Model (MS-VECM). The long run dynamics are confirmed by a cointegrating vector which relates the stock indices of observed markets. The nonlinearity of the estimated model is justified by the Log-likelihood Ratio test and the information criteria. The MS-VECM with two regimes provides an adequate illustration the of level of market integration and stability from the perspective of a regional market position. Furthermore, the model shows an ability to capture every change in the financial time series data. Also, modeling the shifts can be encouraged by the fact that the change in and between regimes should be considered as a random, unpredictable event. Finally, the study have implications regarding market efficiency hypothesis which impacts international or regional portfolio diversification and the long term economic growth prosperities. Moreover, the results show that the diversification benefits for international investors with long horizon strategy in the stock markets are quite limited.*

Keywords*: vector error correction model, markov switching, integration, stock market*

1. INTRODUCTION

Along with the beginning of the financial crisis during the 2008, it became clear that financial markets worldwide are no longer national. Stock indices were falling dramatically, while market participants were desperately seeking for better investment opportunities by following information from other stock markets. In this way, mentioned investors are trying to find new ways to yield higher returns and better risk diversification of investment portfolio.

As capital becomes borderless, the improvements in allocation efficiency and reductions in volatility have elevating the benefits of economic growth (Masood et al., 2010). Furthermore, appearance of liberalization of financial markets promotes market integration with serious consequences on efficient implementation of investment politics. One should not be ignored that an increase of market integration and its openness could lead to an increase of volatility and exposure to unwanted market equilibrium disturbances. Therefore, a transmission of market turbulences is likely higher if international financial markets are well integrated (Assidenou, 2011). Emerging financial markets are becoming less isolated to main world market movements and economic growth created by efficient financial allocation and decreases of macroeconomic volatility (Baele et al., 2004).

A financial market cointegration becomes crucial not only to the economic theory, but to an active investment portfolio management. According to the financial theory, if there is a confirmation of accepting any of three versions of the efficiency market hypothesis, than returns, yielded by investment activity, can not be predicted using any kind of public financial data. Such a phenomenon disqualifies any adjustment among financial markets over time. Hence, with existence of cointegrating relations between financial markets, the market efficiency hypothesis is rejected since mentioned markets poses relevant information about each other. On the other hand, a lack of cointegrating relationships creates investment opportunities through better risk diversification of international investment portfolio.

With the development of first methods of measuring long-run relations among financial markets, there has been made several studies that helped in decision making process. Anyway, the stable equilibrium relationships conceived by the cointegration methodology are not appropriate for modeling the dynamics of stock market integration. The traditional linear model does not allow the parameters to adjust for the structural changes. Therefore, many previous works have adopted Markov switching framework in analyzing the relationships between markets. Allowing the involvement of regimes, the mentioned methodology is well suited to domestic and international cycling shifts that affect domestic market. Moreover, it allows for changing relationships among the stock market variables across different time phases. Linked with the basic Markov switching vector autoregression model created by Hamilton (1989), a Markov Switching Vector Error

Correction Model (MS-VECM) has recommended in case of unknown regime shifts of stock market prices. In other words, the model introduce state variable generated by the Markov chain, where the market state of tomorrow is driven only by the present market state (Krolzig, 1997).
Using similar methodology, Scheicher (2001) considers financial markets of Hungary, Poland and Czech Republic and finds that mentioned markets are more influenced by the regional movements. The same author, beginning with the assumption that mentioned markets have no significant long-run connection with major world financial markets, infers that global integration of three markets remains at the same level, while regional integration is significantly high. Comparable results are confirmed by Maneschiold (2006) and Masood et al. (2010) in case of countries from Baltic region. Also, Keneurgios and Samitas (2011) examined cointegration of five emerging Balkan markets through involvement of developed financial markets. These markets show higher integration during the period of financial market breakdown in 2008. Consequently, main goal of this study is to examine short and long run integration of financial markets in region of south east European countries with the attention on the position of Serbian financial market. Also, the focus remains on convergence level of domestic stock markets to new tendencies in the region.

2. METHODOLOGY

The methodology of measuring cointegration between economic variables (Engle and Granger, 1987; Johansen, 1988) is accepted in numerous studies of long-run co-movement among international financial markets. However, long-run equilibrium of cointegration given by the basic methodology is not appropriate in case of modeling dynamic processes of market cointegration. Due to the incomplete procedure which continues to generate strong variations in results over time, it is inevitable to upgrade previous procedure emphasizing the nature of time variations. To fulfill mentioned assumption, this paper contains three supplementing methodology segments:

- Unit root testing,
- Cointegration testing and
- Markov switching vector error correction modeling.

2.1. Unit root testing

In first step, the study examines a stochastic structure of time series by applying the Augmented Dickey-Fuller test (ADF test). The test performs in order to determine the stationarity of time series. The term of stationarity implies the mean reversion in long term and avoids imposed relations in regression. In other words, the presence of these time series leads to a biased implementation of regression analysis. The ADF test begins with the equation:

$$\Delta Y_t = \alpha + \mu T + \omega Y_{t-1} + \sum_{i=1}^{p} \delta \Delta Y_{t-i} + \varepsilon_t \quad (1)$$

Based on equation (1), one tests the null hypothesis about random walk of variable Y, which implies the presence of unit root versus stationary process with trend.

2.2. Johansen's cointegration test

According to cointegration theory, it is possible to determine a cointegration relationship between time series if their first differences are stationary. Such an analysis uses Johansen's procedure of maximum likelihood as a framework for estimation and testing of cointegration relations. Therefore, mentioned procedure incorporates different short and long-run dynamic relations in the multiple variable system, as fallows:

$$\Delta Y_t = \mu + \Pi Y_{t-p} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \varepsilon_t \quad (2)$$

Where Π is a matrix of the coefficients with lagged variables and Γ_i is a matrix of coefficients with first difference lagged variables. The cointegration test is calculated using ranks of eigenvalues λ. The rank of matrix Π is equal to eigenvalues different from zero. Eigenvalues are sort ascending $\lambda_1 \geq \lambda_2 \geq ... \geq \lambda_g$. Using Johansen's approach, it is possible to form test statistics of the following form:

$$\lambda(r) = -T \sum_{i=r+1}^{g} \ln(1 - \hat{\lambda}_i) \quad (3)$$

Where r is the number of cointegrated vectors based on the null hypothesis, while $\hat{\lambda}_i$ is an estimated value of the i-th eigenvalue from matrix Π. $\lambda(r)$ is a mutual test where the null hypothesis represents the number of cointegrated vectors less than or equal to r versus an alternative hypothesis that the number is greater than r.

2.3. Markov Switching Vector Error Correction Model

A vector error correction model (VECM) means a type of vector autoregressive model (VAR) with cointegration constraints installed the model specification. The model design itself is made for estimating relations between nonstationary time series. Therefore, limited application of the model demands previous cointegration testing. Although a vector error correction model is considered as an alternative to basic vector autoregressive model in cointegration relations estimation, it also has numerous limitations (Phoong et al., 2014). In such a model, the constancy of variance and covariance over time can significantly affect a reliability of model estimation. Besides, the presence of autocorrelation becomes sensitive matter in terms of number of lags include in the model. All of this guides to the introduction of the new type of a model with Markov chains, where variance and covariance are followed by the probability (state) variable.

A MS-VECM represents a special form of model in different time series regimes. This model is specially recommended in cases when the price changes (price regimes) are unknown. Thus, price changes in this model have stochastic feature. In other words, the state variable is introduced and it generates by the Markov chains, where tomorrow state of market is driven only by the today's state (Krolzig, 1997). The form of a Markov switching vector error correction model can be presented as follows:

$$\Delta Y_t = \nu(s_t) + \alpha(s_t)(\beta(s_t)'Y_{t-1}) + \sum_{i=1}^{p-1} A_i(s_t)\Delta Y_{t-i} + \varepsilon_t \tag{4}$$

Where Y_t denotes a vector of stock market indices values, $\nu(s_t)$ is a vector of intercept term, $\alpha(s_t)$ denotes a vector of the speed of adjustment coefficients, $\beta(s_t)$ is a long-run cointegrating vector and A_i is a matrix of short-run parameters, capturing the autoregressive part of price movements. One should emphasized that the main segment of equation (4) is state variable $s_t = 1,...,M$. All parts of the model specification involving this variable. Therefore, the probability of being in state s in period t is presented in expression (5).

$$P\left(s_t | s_{t-i}, \Delta Y_{t-1}, \beta' Y_{t-1}\right) = P\left(s_t | s_{t-i}, \Pi\right) \tag{5}$$

Where the square matrix Π contains probabilities π_{ij} for switching from the regime in row i to the regime in column j, conditioned on the regime in the previous period.

3. EMPIRICAL ANALYSIS

This paper studies the relationships among six emerging stock markets of South East Europen Countries (Bulgaria, Bosnia and Hercegovina, Croatia, Romania, Serbia and Slovenia). We decide to study these markets separately from global financial trends, since the stock markets in this region remain small in terms of capitalization, turnover and liquidity compared to developed countries. Also, this paper uses the period of time after the financial crisis, i.e. from the first moment of an obvious positive trend of stock indices. Therefore, the sample of six major stock exchange indices in mentioned stock markets (SOFIX, SASX-10, CROBEX, BET, BELEX15 and SBITOP) is collected from August 15, 2009 to December 31, 2015 or 1610 daily observations of stock index values. Table 1 presents descriptive statistics of stock indices returns in observed period of time.

Table 1: Descriptive statistics

Stock index	BELEX15	SASX-10	CROBEX	SBITOP	SOFIX	BET
mean	0.00016	-0.00035	0.00000	-0.00007	0.00022	0.00038
st deviation	0.01134	0.00942	0.01024	0.00999	0.01602	0.01910
maximum	0.08317	0.05938	0.08563	0.03721	0.18171	0.15188
minimum	-0.07580	-0.06940	-0.07020	-0.06059	-0.13741	-0.13709
skewness	0.43307	0.21968	0.26851	-0.20866	-0.25598	-0.25621

kurtosis	10.19771	9.58702	13.05516	5.37702	11.60195	11.63244
ρ(1)	0.25156	0.11682	0.10412	0.08303	-0.01674	-0.00104
ρ(2)	0.11627	0.01205	-0.01613	-0.00911	0.06025	0.01670
ρ(3)	0.03600	0.01401	0.06805	-0.02782	-0.03048	-0.00926
ρ(4)	0.10170	-0.01088	0.03001	-0.00577	0.04637	-0.01435

Table 1 shows daily mean value of stock index returns in observed period of time where only SASX-10 and SBITOP had negative average of returns. Standard deviation of mentioned time series of returns is similar in case of markets from former Yugoslav Republics (BELEX15, SASX-10, CROBEX and SBITOP). First three observed indices had positive skewness, while next three had negative skewness in mentioned period. According to several authors, negative skewness is a feature of developed financial markets, although it brings higher risk of potential investment. All observed indices had leptokurtic distribution (kurtosis>3), which is one of the main characteristics of financial data. Finally, autocorrelation coefficients ρ(i) did not show any sign of significant correlations between current index return in time t and lagged return in time t-i.

After a brief analysis of descriptive statistics, the next phase is to test the existence of unit root in time series of index returns using ADF test.

Table 2: Unit root testing

Stock index	ADF test
BELEX15	-2.1341***
SASX-10	-2.9014***
CROBEX	-2.5453***
SBITOP	-1.1819***
SOFIX	-1.7901***
BET	-2.1612***

Table 2 presents the results of ADF test in case of all six indices. *** denotes the level of significance bellow 1%. Hence, all six time series of index values are nonstationary or integrated in first order I(1). Considering the results, the study takes the fallowing step by testing cointegration of nonstationary time series with λ_{trace} Johansen's test.

Table 3: Testing cointegrating relations

No. of CE(s)	Eigenvalue	Trace Statistic	Critical Value	Prob.
None	0.0367	129.4103	95.7537	0.0000
At most 1	0.0184	69.3414	69.8189	0.0545
At most 2	0.0131	39.5366	47.8561	0.2395
At most 3	0.0048	18.2677	29.7971	0.5463
At most 4	0.0036	10.4927	15.4947	0.2447
At most 5	0.0029	4.6413	3.8415	0.0312

According to the mentioned procedure of cointegration testing, the results from Table 3 notice one cointegrated vector (equation) with significance level bellow 1%. It infers that there is some long-run integration among observed time series.

Mentioned results encourage the application of a vector error correction model. This study applies two different model specificiation: linear and Markov switching vector error correction model. Both models are estimated and compared by Likelihood-ratio (LR) test and Akaike information criteria. The tests show superiority of nonlinear model, MS-VECM with two regimes. Consequently, the next sequence of the paper will contain only the results of MS-VECM in case of BELEX15.

Table 4: Transition probabilities matrix

From Regime to Regime	Regime 1	Regime 2
Regime 1	0.97636	0.02365
Regime 2	0.52516	0.47484

Table 4 represents the results of transition probabilities between regimes in case of index BELEX15 returns as a dependent variable in estimated model MS(2)-VECM(1). The regime 1 is the standard regime where the volatility of returns is not to high, while the regime 2 is an extreme one where the volatility of returns is high.

At the intersection of row and column in Table 4 are the probability results of transition between regimes. Regime 1 keeps the high level of probability if it stays in the same regime. On the other hand, regime 2 has smaller probability of staying in the same regime. The following Table 5 will present the estimated model MS(2)-VECM(1).

Table 5: Estimated model MS(2)-VECM(1) in case of BELEX15

Variable		Parameter	t - statistics
regime dependent intercept	v_1	0.03699	15.2174
	v_2	-0.00055	-1.68979
short run dynamics	$\Delta BELEX_{t-1}$	0.27759	9.81806
	$\Delta CROBEX_{t-1}$	0.07550	3.13114
	$\Delta SOFIX_{t-1}$	-0.02375	-1.83588
	$\Delta SBITOP_{t-1}$	0.08630	3.59641
	$\Delta SASX_{t-1}$	0.08474	3.12833
error correction	ecm_{t-1}	-4.65868	-235.252
long run dynamics	Regime 1	0.11095	4.66905
	Regime 2	0.18593	3.48221

Estimated Markov switching vector error correction model is presented in Table 5. There are three main components that could be identified by interpreting the results from the model: short and lon-run market integration, market stability and average regime duration.

The market integration will be investigated by the estimated parameters, presented in Table 5. Regime dependent intercepts v_1 and v_2 are the model starting point coefficients. These coefficients are significantly different between regimes. The parameters estimated with $\Delta BELEX_{t-1}$, $\Delta CROBEX_{t-1}$, $\Delta SOFIX_{t-1}$, $\Delta SBITOP_{t-1}$, $\Delta SASX_{t-1}$ represent the autoregressive parts of the model in short-run with non-switching parts. The index BET is excluded from the model due to the statistical significance. Therefore, we noticed some weaker linkage between BELEX15 index and BET index in short-run. In addition, the model shows a potential problem with the significance level in case of SOFIX index. Hence, in short-run the strong connections are noticed in case of four observed market indices from former Yugoslav Republics. The error correction term is highly statistically significant, which means that BELEX15 is able to adjust to new trends in the mentioned region. In other words, the region of South East European financial markets is highly integrated in long-run and partly in short-run. Long-run dynamics parameters show strong long run integration of BELEX15 in region of south east European stock markets in both regimes. These two parameters are also represented as elasticity parameters which show long run transmission of the price changes from the mentioned region to Serbian financial market. There is no significant difference in elasticity parameters between regimes.

The stability of the national financial market is investigated using filtered probabilities of dependent variable being in one of two mentioned regimes. Applying estimated MS(2)-VECM(1), Figure 1 represents distribution of those probabilities in observed sample period.

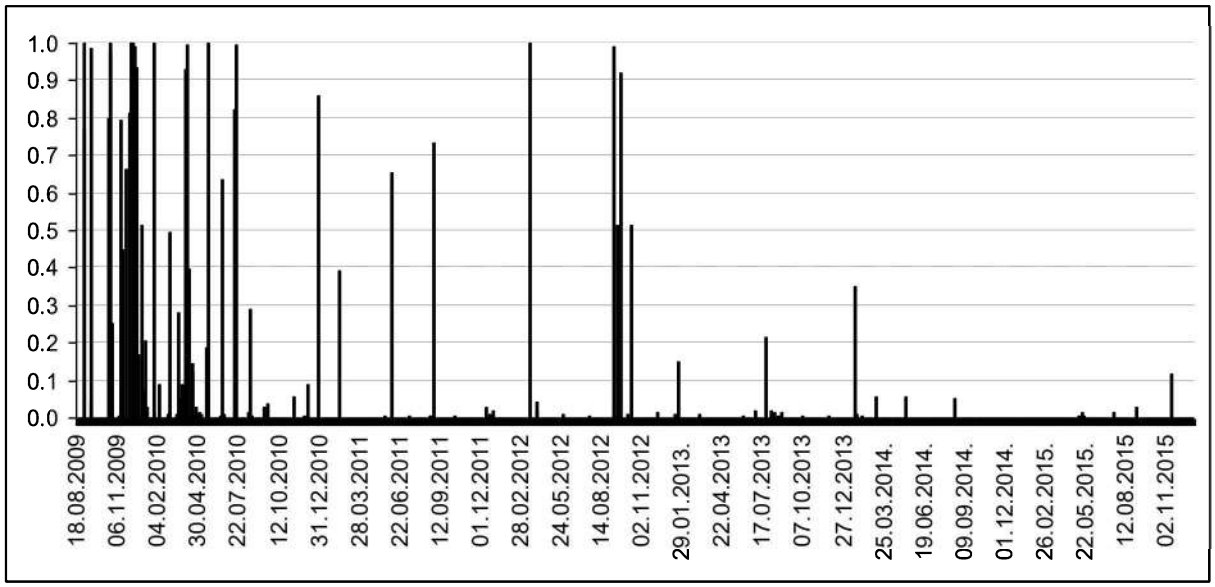


Figure 1: Filtered probabilities of being in regime 2

Figure 1 presents filtered probabilities of state variable being in regime 2 (regime of extreme changes). The most of the sample time the state variable was in regime 1. This figure points out that BELEX15 is in period of stabile price changes, especially in last 4 years where extreme regime appeared in only few observations and, what is even more important, it does not retain in following daily observations. Moreover, only 32 of 1610 daily observations, involved in the analysis, have the probability of being in regime 2 more than 50%.

To support the fact about market stability, the estimated MS(2)-VECM(1) provide the average time duration of each regime. Accordingly, dependent variable (BELEX15 index) retains in the period of stabile price changes for 42.2917 daily observations in average, while the period of extreme price changes last for 1.9042 daily observations in average.

4. CONCLUSION

Serbian financial market and other observed market due to their size and volume of trade belong to the category of small emerging markets in global scale. Therefore, it is inevitable to analyze international, as well as regional, financial effects before any investment decision making. Such an approach brings an opinion about the level of market integration and stability from the perspective of a regional market position. From the estimated results, it is obvious that the movement of BELEX15 index is highly connected with the signals from the neighboring financial markets. However, price stability in observed market shows that they became less immunized to external movements. For that reason, the results of the estimated MS(2)-VECM(1) indicate that both domestic and external factors shape the long-run equilibrium of mentioned stock markets.

According to growing integration between neighboring markets, the results have implications regarding market efficiency hypothesis which impacts international or regional portfolio diversification and the long term economic growth prosperities. In other words, the diversification benefits for international investors with long horizon strategy in the stock markets are quite limited. However, small number of significant extreme regime appearance probabilities in last three years creates favourable conditions to attract many domestic and foreign rational investors.

REFERENCES

Assidenou, K.E. (2011). Cointegration of Major Stock Market Indices during the 2008 Global Financial Distress. International Journal of Economics and Finance, 3(2), 212-222. doi:10.5539/ijef.v3n2p212

Baele, L., Ferrando, A., Hordahl, P., Krylova, E., & Monnet, C. (2004). Measuring Financial Integration in the Euro Area. Occasion Paper 14, European Central Bank.

Engle, R., & Granger, C. (1987). Co-integration and Error Correction: Representation, Estimation and Testing. Econometrica, 55(2), 251-276. ISBN: 0-521-79697-0

Hamilton, J.D. (1989). A New Approach to the Econometric Analysis of Nonstationary Time Series and Business Cycle. Econometrica, 57(2), 357-384. doi:10.2307/1912559

Johansen, S. (1988). Statistical Analysis of Cointegration Vectors. Journal of Economic Dynamics and Control, 12(2), 231-254. doi:10.1016/0165-1889(88)90041-3

Kenourgios, D., & Samitas, A. (2011). Equity Market Integration in Emerging Balkan Markets. Research in International Business and Finance, 25(3), 296-307. doi: 10.1016/j.ribaf.2011.02.004

Krolzig, H.M. (1997) Markov-Switching Vector Autoregression – Modelling, Statistical Inference, and Application to Business Cycle Analysis. Berlin: Springer-verlag.

Maneschiold, P. (2006). Integration between the Baltic and International Stock Markets. Emerging Markets Finance and Trade, 42(6), 25-45. doi:10.2753/REE1540-496X420602

Masood, O., Bellalah, M., Chaudhary, S., Mansour, W., & Teulon, F. (2010). Cointegration of Baltic Stock Markets in the Financial Tsunami: Empirical Evidence. International Journal of Business, 15(1), 119-132. ISSN: 1083-4346

Phoong, S.W., Ismail, M.T., & Sek, S.K. (2014). Linear Vector Error Correction Model versus Markov Switching Vector Error Correction Model to Investigate Stock Market Behaviour. Asian Academy of Management Journal of Accounting and Finance, 10(1), 133-149. ISSN: 2180-4192

Scheicher, M. (2001). The Co-movements of Stock Markets in Hungary, Poland and Czech Republic. International Journal of Finance and Economics, 6(1), 27-39. doi:10.1002/ijfe.141

IMPACT OF THE EFFICIENCY OF THE TAX ADMINISTRATION ON THE MACROECONOMIC STABILITY

Gordana Savić *[1], Aleksandar Dragojlović[2]
[1] Faculty of Organizational Sciences, University of Belgrade, Serbia
[2]Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Serbia
*Corresponding author, e-mail: gordana.savic@fon.bg.ac.rs

Abstract: *In this paper, we analyze the performance of the system for the administration of public revenues by mathematical modeling. Due to the economic crisis, the governments in many countries implement radical fiscal measures. Fiscal consolidation is a key element for creating a stable macroeconomic environment. In this regard, the establishment of an efficient tax administration is one of the key factors for creating macroeconomic stability and attractive business environment. The quality of a business environment has strong positive influence on the level of direct investments in every country. The obtained results have showed that the countries in which the tax administrations are efficient, resulting in a more stable macroeconomic environment, which leads to a higher levels of foreign direct investment. Strong institutions and a high level of foreign direct investments are the way to improve economy and to increase standard of living in countries.*

Keywords*: tax administration, data envelopment analysis, foreign direct investments*

1. INTRODUCTION

Tax Administration is essential for every country. In the situation with full tax compliance, which is extreme and an ideal situation, the role of the Tax Administration would be restricted to the provision of facilities for citizens to discharge their responsibilities to the society. In the case of non-compliance, the Tax Administration will have to play the role of policeman. Due to lack of resources and in the situation that it cannot play the role of a policeman to all taxpayers, one of the solutions is to support a voluntary compliance. In that sense, the fundamental role of the Tax Administration is to render quality taxpayer services and to encourage voluntary compliance of tax laws, to detect and penalize non-compliance. The extent of success of the Tax Administration in its role should be reflected through a higher revenue growth. Only with collected taxes, governments are able to provide all public services and to implement welfare programs. In addition, the level of grey economy is one of the parameters of a state in economy. It can be said that there is a connection between business environment regulations and the level of grey economy. Better environment regulations lead to a lower level of the grey economy because enterprises do not have incentives to go in the grey economy on one side and going into the grey economy is punishable on the other side. Adequate environment in which enterprises operate will encourage them to stay in formal economy. In other words, the level of grey economy is lower and enterprises are more responsible to pay taxes in a more regulated business environment. That creates culture where cheating the government is not acceptable and even more than that, it is punishable. In addition, quality of business environment has strong influence on the level of direct investments into every country. Having this in mind, a better regulated business environment will attract more foreign direct investments. In that sense, countries have to strive to attract direct investments in order to increase quality of their economies. To establish pro-business environment and to increase investments, an effective and efficient Tax Administration is a necessary element. The increasing efficiency and effectiveness of Tax Administration will surely be followed by decreasing level of the grey economy and a more friendly business environment for foreign investments.

The taxpayer's decision to comply, or not to comply, with his fiscal obligations has been the subject of considerable literature on the themes of tax evasion (Bird, 2004). There are two different paradigms that are used in order to encourage tax compliance, each with different implications for tax compliance behaviour. The first paradigm is a standard economic model of tax evasion based on the economic theory of crime that emphasizes repression of illegal behaviour through frequent audits and rigid penalties. The second paradigm recognizes the role of enforcement strategy (audit and penalties), but also emphasizes the role of tax administrators as facilitators and a providers of services to taxpaying. It stresses the role of social norms in tax compliance, in the sense that the government can change tax compliance by changing the social norm of tax compliance (Bird, Martinez-Vazquez & Alm, 2003: 156). Regarding Tax theory, focus will be on the services provided by the tax administration to increase tax compliance (second paradigm) but we should have to bear in mind that enforcement elements are the second very important part to increase tax

compliance (first paradigm). This paper aims to compare the efficiency of the systems for the administration of public revenues among different develop and developing countries. Similar attempt is made by Savić at. al (2015) who tried to establish the linkage between the tax administration efficiency and tax evasion in 17 European union members and non-members. They proposed two stage methodology consists of the data envelopment analysis for the tax administration efficiency evaluation and regression model defined to find out the relation between a level of grey economy and level of the tax administration efficiency, GDP level and other characteristics of economy. The results have shown the strongest impact of tax administration efficiency on the decreasing the level of grey economy. This paper is organized as follows. A DEA based methodology in given in the second chapter. A DEA efficiency measurement of the tax administration systems is given the chapter 3, followed by conclusion remarks and literature.

2. METHODOLOGY

The idea of efficiency measurement was developed by Farrell (1957) when he used non-parametric efficiency limits approach to measuring the efficiency of the relative distances from the efficient frontier. This measure, which is well known as empirical or relative efficiency was later expanded in the work of other researchers. Data Envelopment Analysis (DEA) was introduced by Charnes, Cooper and Rhodes (1978). Their model is known as CCR model. Business units, their activities or processes in the DEA terminology are seen as Decision Making Units (DMU). DMU is the unit that actually make business decisions, and whose performance is characterized by a set of inputs and outputs, and their interdependence. It operates with constant returns to scale (CRS) which implies that a change in the amounts of the inputs leads to the same proportional change in the amounts of the outputs. Efficiency ratio is scaled between 0 and 1, and all efficient units have the same ratio equal to 1. Following this model, Banker, Charnes, and Cooper (1984) have extended the original CCR model by introducing the assumption of variable returns to scale (VRS). In the literature this model is known as a BCC model. The VRS efficiency scores measure pure technical efficiency excluding the effects of scale operations. They are greater than the corresponding CRS efficiency scores. BCC model is able to distinguish between technical and scale inefficiency. Technical inefficiency is calculated by measuring how well the unit uses its inputs to create outputs, while scale inefficiency identifies whether increasing, decreasing, or constant returns to scale exist. There are two main orientation of DEA model: input and output orientation. Input-oriented DEA model aims to minimize the input with given level of output. On the other side, in output-oriented DEA model aim is to maximize the output with given level of input. In the envelopment model, the number of degrees of freedom will increase with the number of DMUs and decrease with the number of inputs and outputs. A rule of thumb which can provide guidance is as follows (Cooper, Seiford, and Tone, 2000): $n \geq \max\{m \times s, 3 \times (m+s)\}$; where n is number of DMUs, m is number of inputs and s is number of outputs. This pre-condition has been fulfilled by the analysis in this paper.

Consider a set of n DMUs, with each DMUj, j = 1,..,n, using m inputs x_{ij} (i = 1,...,m) and generating s outputs y_{rj} (r=1,...,s).Then the primal linear program for the (input-based) CCR model, that gives optimal efficiency score θ^* for DMU0, can be written as:

$$\theta^* = \min \theta \tag{1}$$

s.t.

$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{r0}, \quad r = 1,...,s \tag{2}$$

$$\sum_{j=1}^{n} \lambda_j x_{ij} \leq \theta x_{i0}, \quad i = 1,...,m \tag{3}$$

$$\lambda_j \geq 0, \quad j = 1,...,n \tag{4}$$

where θ is the efficiency score for the particular DMU, x_{i0} and y_{r0} are, respectively, the i-th input and r-th output for DMU_0 under evaluation, while λ_j represent unknown value assigned to DMUj, j=1,...,n. The efficient frontier consists of DMUs with $\lambda_j \neq 0$. The dual linear program to model (1)-(4) is

$$\max \sum_{r=1}^{s} u_r y_{r0} \tag{5}$$

s.t.

$$\sum_{i=1}^{m} v_i x_{i0} = 1 \tag{6}$$

$$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \leq 0, \quad j = 1, 2, ..., n \tag{7}$$

$$u_r \geq 0,\ r = 1,...,s$$
$$v_i \geq 0,\ i = 1,...,m \tag{8}$$

where u_r is the weight assigned to output r, r=1,..,s and u_i is weight assign to input i, i=1,..,m. A DMU_0 is said to be CCR efficient if and only if θ^*= 1 and all optimum slack values obtained by solving model (1)-(4).

In this paper DEA is used for comparative analysis of tax administration efficiency in the selected countries. Procedure of DEA method applying could be divided into following steps (Popović, and Martić, 2005):

1. Choosing and definition of DMU's,
2. Defining relevant inputs and outputs,
3. Choosing adequate DEA model, and
4. DEA model solving, analysing and interpretation of results.

At this point, we will emphasize the importance of choosing the adequate DEA model. This choice will depend on the context of research, and the previous two phases in its implementation. A set of countries that are assessed in this research consists of countries classified in the group of high income and countries with upper-middle income according to the World Bank classification. Therefore, it can be said that they belong to distinguish a group and adequate DEA models for the comparison between different systems and bilateral DEA model are going to be used.

Efficiency comparison between different systems is achieved by solving the mixed integer linear programming model (Cooper, Seiford & Tone, 2000). The set of n DMUs is divided into a set A and set B and model is defined as follows:

$$\theta^* = \min \theta \tag{9}$$

s.t.

$$\sum_{j \in A} \lambda_j^A y_{rj}^A + \sum_{j \in B}^{n} \lambda_j^B y_{rj}^B \geq y_{r0}, \quad r = 1,...,s \tag{10}$$

$$\sum_{j \in A} \lambda_j^A x_{ij}^A + \sum_{j \in B} \lambda_j^B x_{ij}^B \leq \theta x_{i0}, \quad i = 1,...,m \tag{11}$$

$$0 \leq \lambda_j^A \leq z_j^A, \quad j \in A \tag{12}$$

$$0 \leq \lambda_j^B \leq z_j^B, \quad j \in B \tag{13}$$

$$z_j^A + z_j^B = 1, \quad j \in B \tag{14}$$

$$\lambda_j^A \geq 0,\ z_j^A \in \{0,1\}, j \in A,\ \lambda_j^B \geq 0,\ z_j^B \in \{0,1\}, j \in B, \tag{15}$$

where z_j^A and z_j^B are binary variables define that production possibility set consists of DMUs belongs to the set A ($z_j^A = 1,\ z_j^B = 0$) or to the set B ($z_j^A = 0,\ z_j^B = 1$). For example, the reference set for $\mathrm{DMU}_0 \in A$ can be consists of DMUs in set A or B (*inter* and *within* comparison) and *vice versa*. The model can be solved as a sequence of two linear models and choosing an optimal value $\theta^* = \min\{\theta_A, \theta_B\}$. Strict *inter* comparison (the reference set for $\mathrm{DMU}_0 \in A$ can be consists exclusively of DMUs in set B and vice versa) can be done with by solving the following model:

$$\theta^* = \min \theta \tag{16}$$

s.t.

$$\sum_{j \in B}^{n} \lambda_j y_{rj}^B \geq y_{r0}, \quad r = 1,...,s \tag{17}$$

$$\sum_{j \in B} \lambda_j x_{ij}^B \leq \theta x_{i0}, \quad i = 1,...,m \tag{18}$$

$$\lambda_j \geq 0,\ j = 1,...,n \tag{19}$$

The two systems A and B can be compared by observing efficiency of each DMU in each system. For that purpose, nonparametric Wilcoxon Mann-Witney rank-sum is used to identify weather the difference between

two groups is significant. Presented models are used for the efficiency evaluation of tax administration systems in 94 countries.

3. DEA EFFICIENCY MEASUREMENT

In the DEA analysis the following input and output parameters have been used. The parameters are determined by goal definition that is measuring the efficiency of the tax administration. All input and output parameters relating to the year 2013. The following inputs are used:

- Time to comply–corporate income tax (I1)
- Time to comply –labour tax (I2)
- Time to comply –consumption tax (I3)
- Tax payment - profit tax (I4)
- Tax payment – labour tax (I5)
- Tax payment - other taxes (I6)
- Tax rate - profit tax (IN7)
- Tax rate - labour tax (IN8)
- Tax rate - other taxes (IN9)

Tax rates are non-discretionary variables, considering that management cannot influence the decision on their size, and they are out of reach decision makers. On the other hand, the output parameters are:

- The level of foreign direct investment, in dollars (O1)
- Gross domestic product in dollars (O2)

Tax administration plays an important role in ensuring overall macroeconomic stability, which has a positive impact on foreign direct investment (Barthel et al, 2008; Shahzad and Al-Świda, 2013). On the other hand, foreign direct investment is an important element of economic growth (Lim, 2001). Selected input and output parameters are important for tax administration businesses and they are derived on the basis of the existing models for assessing the performance of tax administration (European Commission, 2007; the International Finance Corporation, 2015; International Monetary Fund, 2012; World Bank, 2012). Input parameters represent the efficiency of the tax administration in establishing a stable macroeconomic and fiscal environment, while output parameters represent the level of development of the country and attractiveness for foreign direct investments. In this model, the tax administration has the role as a key factor for attracting foreign direct investment through the creation of preconditions for their attraction. The value of the input and output parameters is given in Table 1 in Annex. DMUs have been selected on high income countries and countries with upper-middle income defined by the World Bank classification. The total number of countries is 94, out of which 48 countries with high-income countries, and 46 countries with upper middle income.

Table 1. Descriptive statistics of results

		DEA CRS		Bilateral DEA CRS					
				High-Income Countries		Upper-Middle Income Countries		**Total**	
	Range	#	%	#	%	#	%	#	%
Efficiecny Score	< 0.2	38	40.43%	4	8.33%	34	73.91%	38	40.43%
	0.2 - 0.4	17	18.09%	8	16.67%	9	19.57%	17	18.09%
	0.4 - 0.6	15	15.96%	12	25.00%	3	6.52%	15	15.96%
	0.6- 0.8	4	4.26%	4	8.33%	0	0.00%	4	4.26%
	0.8 - 1.0	3	3.19%	3	6.25%	0	0.00%	3	3.19%
	1.0	17	18.09%	17	35.42%	0	0.00%	17	18.09%
Total		**94**		**48**		**46**		**94**	
	Average	0.797		0.634		0.157		0.401	
	Min	1		0.319		0.013		0.013	
	Max	0.349		1		0.514		1	
	SD	0.216		0.091		0.109		0.339	

The efficiency assessment and comparison between two groups is done by CCR DEA (1-4) and (5)-(8) and system DEA model (9)-(15). A descriptive statistics of results is given in the Table 1. The models are solved using DEA Solver Pro software (Cooper, Seiford, &Tone K, 2000). The basic results show that there are 17 efficient out of 94 countries no meter if they are compared within or inter group. The second analysis, which compares efficiency of two groups, shows that all efficient countries are in the group 1 of high-income countries. Furthermore, based on descriptive statistics high-income countries with average efficiency scores of 0.634 performs better than upper-middle income counties, which will be check later by comparing efficiencies of two groups and performing rank-sum test.

Afterwards, countries are inter-compared ranked bya bilateral DEA model, and efficiency scores of tax administration are shown in the Table 2.

Table 2. DEA Bilateral Efficiency scores

Rank	DMU	Score	Rank	DMU	Score
1	Bahrain	657.030	49	Chile	0.514
2	Hong Kong SAR, China	276.321	50	Botswana	0.506
3	Netherlands	74.290	51	Iraq	0.459
4	Argentina	50.210	52	Kazakhstan	0.277
5	Croatia	49.668	53	Palau	0.259
6	Luxembourg	40.651	54	Namibia	0.246
7	Saudi Arabia	35.107	55	Libya	0.220
8	Singapore	32.497	56	St. Lucia	0.220
9	Oman	20.844	57	South Africa	0.218
10	Brunei Darussalam	19.861	58	Brazil	0.215
11	United States	19.708	59	Grenada	0.212
12	Australia	19.336	60	Mexico	0.212
13	Bahamas, The	19.273	61	Lebanon	0.200
14	Equatorial Guinea	15.343	62	Turkey	0.196
15	Canada	14.428	63	Romania	0.177
16	Ireland	12.725	64	Belize	0.160
17	Estonia	12.022	65	Thailand	0.157
18	Cyprus	9.901	66	St. Vincent and the Grenadines	0.151
19	France	6.334	67	Azerbaijan	0.139
20	United Kingdom	6.146	68	Bulgaria	0.134
21	Germany	5.827	69	Colombia	0.132
22	Seychelles	5.779	70	Macedonia, FYR	0.130
23	Iceland	5.472	71	Algeria	0.129
24	Spain	5.227	72	Maldives	0.129
25	Austria	5.214	73	Malaysia	0.128
26	Russian Federation	4.853	74	Tonga	0.125
27	Korea, Rep.	4.262	75	Peru	0.123
28	Italy	4.046	76	Dominica	0.117
29	Slovak Republic	3.848	77	Ecuador	0.112
30	Israel	3.762	78	Montenegro	0.111
31	Malta	3.683	79	Costa Rica	0.103
32	Portugal	3.502	80	Belarus	0.100
33	Greece	2.849	81	Gabon	0.095
34	Latvia	2.838	82	Fiji	0.094
35	Japan	2.786	83	Bosnia and Herzegovina	0.088
36	Czech Republic	2.514	84	Panama	0.083
37	Lithuania	2.417	85	Jordan	0.079
38	Slovenia	2.093	86	Marshall Islands	0.075
39	Trinidad and Tobago	1.597	87	Dominican Republic	0.074
40	Poland	1.546	88	Iran, Islamic Rep.	0.067
41	Barbados	1.540	89	Jamaica	0.056
42	St. Kitts and Nevis	1.385	90	Paraguay	0.051
43	Uruguay	1.105	91	Serbia	0.047
44	Venezuela, RB	1.020	92	Mongolia	0.046
45	United Arab Emirates	1.000	93	Albania	0.036
45	Chile	1.000	94	Mauritania	0.013
45	Kuwait	1.000			
48	Grenada	0.969			

Based on the results, the null hypothesis is rejected that the two groups have similar distribution of the results, with the test statistic 6.813. As it is expected efficiency of the group 1 prevailed efficiency of group 2. Tax administrations in high-income countries are more efficient then the tax administrations in upper-middle income countries.

Special attention is paid on tax administration efficiency in Serbia. Serbia belongs to a group of upper-middle income countries as 91 out of 96 countries. The input-output values, projections and reference set are given in Table 3. Obviously, all inputs, regardless of whether they are related to time to comply, tax payment or tax rate, should be reduced for more than 90% in order to become efficient tax administration with current level of outputs. On the bottom of the Table 3, last two rows show that average changes need for achievement of full efficiency is between 63% and 79% in group 1, while the average required changes for the group 2 are from 86% to 95%. Therefore, the required changes in Serbia are above average for the group 2.

Table 3. Serbia - efficiency results

Countries		**Score**	**Reference set**							
Serbia		0.0467	. Hong Kong, Ireland, Luxembourg, Singapore							
		I1	I2	I3	I4	I5	I6	I7	I8	I9
	Values	48.00	126.00	105.00	12.00	12.00	43.00	16,2	20,2	2,2
	Projection	2.24	1.72	1.29	0.25	0.56	0.36	0.76	0.94	0.03
	Change	-95.33%	-98.63%	-98.77%	-97.88%	-95.33%	-99.17%	-95.33%	-95.33%	-98.43%
High-income	Average projection	-72.88%	-78.29%	-77.99%	-65.29%	-64.87%	-78.99%	-68.95%	-63.63%	-77.00%
Upper-middle income		-90.92%	-92.53%	-95.44%	-88.99%	-87.98%	-93.32%	-92.18%	-86.56%	-94.44%

4. CONCLUSIONS

In the paper, it was assessed the efficiency of the system for the administration of public revenues by DEA methods. It was used bilateral DEA model for conducting an analysis. The results have showed that the countries in which the tax administrations are efficient, resulting in a more stable macroeconomic environment, which leads to a higher levels of foreign direct investment. Actually, Tax Administration's influence on the level of direct investments is reflected through the set up an adequate business environment and in establishing macroeconomic stability. Furthermore, these two elements are complementary to each other. Namely, macroeconomic stability has a strong positive influence on business environment, and the other way around. In addition to that, both elements have positive influence on the level of direct investments in transition countries. Strong institutions and a high level of foreign investments are the way to improve economy and to increase standard of living in countries. Decreasing the level of grey economy and increasing the level of foreign investments are possible only with a strong Tax Administration. Moving Serbia towards EU will have positive influence on the capacity of the Tax Administration on one side and on the level of the underground economy (business environment) and macroeconomic (fiscal) stability on the other side. As a result, level of direct investments will increase and that will lead to higher living standard for all citizens in Serbia. Based on previous experience of new EU members, EU membership brings improvements to the capacity of Tax Administration, lower levels of grey economy and increasing levels of foreign direct investments. Accordingly, Serbia has to follow this path in order to improve its own economy and quality of life for all citizens.

REFERENCES

Barthel, F., Busse, M., & Osei, R. (2008). The Characteristics and Determinants of FDI in Ghana. HWWI Research Paper, 2 – 15.

Bird, R. M. (2004). Administrative Dimensions of Tax Reform. International Burea of Fiscal Documentation, *Asia-Pacific Tax Bulletin,* 10 (3), 3-21.

Bird, R. M., Martinez-Vazquez, J., & Alm, J. (2003). Public finance in developing and transitional countries. Edward Elgar Publishing

Charnes, A., Cooper, W., and Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research*, 2(6), 429-444.

Cooper,W., Seiford, L., & Tone, K. (2000). Data Envelopment Analysis: A Comprehensive Text with Models, Applications, References and DEA-Solver Software. Kluwer Academic Publishers, Boston.

European Commission. (2007). Fiscal Blueprints: A path to a robust, modern and efficient tax administration. Taxation and customs union.

Farrell, M.(1957). The Measurement of Productive Efficiency. *Journal of Royal Statistical Society*,120, 253-281.

International Finance Corporation (IFC). (2015). Paying taxes 2015:The global picture. The World Bank.

International Monetary Fund (IMF).(2012).Revenue Administration's Fiscal Information Tool. The IMF.

Lim, E. (2001). Determinants of and Relationship between Foreign Direct Investment and Economic Growth: A Summary of Recent Literature. IMF Working Paper, 175.

Popović, G, & Martić, M. (2005).Two-stage DEA use for assessing efficiency and effectiveness of micro-loan program. The proceedings of the7th Balkan Conference on Operational Research„ Bacor05“, Constanta, Romania.

Savić G, Dragojlović A, Vujošević M, Arsić M & Martić M., (2015), Impact of the efficiency of the tax administration on tax evasion, *Economic Research-Ekonomska istraživnja,* 28(1),1138-1148.

Shahzad, A. & Al-Swidi, A. K.(2013). Effect of Macroeconomic Variables on the FDI inflows: The Moderating Role of Political Stability: An Evidence from Pakistan, *Asian Social Science;* 9(9), Canadian Center of Science and Education.

World Bank. (2012). Integral Tax Administration Assessment Model. The World Bank. http://data.worldbank.org/indicator/BM.KLT.DINV.GD.ZS

http://data.worldbank.org/indicator/NY.GDP.PCAP.CD?page=5

PROGRAM BUDGETING OF LOCAL AUTHORITIES IN SERBIA – A TOOL FOR CITIZEN PARTICIPATION AND SUSTAINABLE DEVELOPMENT

Vladimir Jovanović[1], Snežana Knežević[2]
[1]Standing Conference of Towns and Municipalities, National Association of Local Authorities in Serbia, vladimir.jovanovicbg@gmail.com
[2] Faculty of Organizational Sciences, University of Belgrade, knezevics@fon.bg.ac.rs

Abstract: *This paper shows challenges in process of creating and executing program type budget, as a relatively new concept for local authorities in Serbia. It aims to show importance of this concept from the perspective of citizens' participation, and its relation with the process of strategic planning. The paper shows significance of realistic and reachable strategic goals foreseen in local strategic documents as a precondition for preparation of program budget for a budget and following two fiscal years.*

Keywords*: local authorities, budget, strategic plans, citizens' participation*

1. INTRODUCTION

Regardless of the political system in any given state, local self-government (if it exists as such) performs functions that represent counter-balance of central authorities, performing along the way corrective role of central government. The other reason for having local level of government is that it satisfies the needs of local citizens, which could not be fulfilled by central authorities. In countries that have established local authorities, apart from traditional division of authorities into independent branches (legislative, executive and judiciary), there is also a vertical division into central and one or more levels of local authorities.

Adopting a number of laws after year 2000, and Adopting the Constitution of the Republic of Serbia in 2006, foundations for modern local self-governments were set, and they remain, more or less unchanged till present day. Constitution of the Republic of Serbia (2006) in article 87, guarantees property of local authorities. The fact this is stated in the Constitution tells about determination of a country to pace a road of independence for local authorities and their autonomous functioning. Through a number of adopted laws that followed Constitution, local self-government in Serbia got clear systemic foundations, financial position was improved, new competences introduced, primary steps in establishing international cooperation taken and a number of projects supported by bilateral donations initiated and conducted.

Scope of activities of local self-governments is set in Constitution and Law on Local Self-Government (2007). Applying the method of enumeration in both of these legal acts, legislators strived for precise definition of whole spectrum of responsibilities and tasks that should fall under primary scope of work of local authorities. Apart from that, there is also a number of tasks that central authorities assign to local governments. Separate (so called sectorial) laws regulate these tasks. It is important to understand that these assigned tasks still lay under responsibility of central authorities, although performed by local ones. It would be reasonable that these assigned tasks are under responsibility of those by whom they are performed, and that they are followed by transfer of funds from central budget, so tasks additionally given to local authorities could be adequately performed. It is unfortunate that is still not always the case. Transferring just tasks without appropriate funds puts towns and municipalities in rather unsuitable position, making them provide and deliver new services out of already tight budget they have on their disposal.

Significant developments and improvements in the legal and regulatory framework, including the system of local government financing, are still expected in period ahead of us. Moreover, as Serbia approaches a potential date for EU accession, the need for preparations within local authorities will grow. Higher-quality services, enhanced dialogue with stakeholders and more efficient local administrations will be essential if municipalities, and indeed the country as a whole, are to meet EU standards and make the most of the opportunities that accession will bring.

2. STRATEGIC DOCUMENTS AND PRINCIPLE OF GOOD GOVERNANCE

Serbian national government has adopted several strategic documents in past several years, with particular emphasis on good governance and public administration reform. *The national objective identified in The*

National priorities for international assistance (2014-2017 with 2020 projections) is "to achieve standards of Good Governance by creating an efficient, effective, transparent and professional public administration that fits the needs of the citizens and business and contributes to sustainable social and economic development of Serbia" (p. 85). Another strategic document Fiscal Strategy of for 2015 with projections for 2016 and 2017 recognizes that in order to establish long-term sustainability of public finances, the implementation of the structural reforms of public sector should be speeded up, referring primarily to the public administration system, the public finances management, and local public finances management (p. 82-88).

In order to respond to requirements of EU accession process and adopted strategies of National Government, local governments of Serbia started addressing one of the many requirements put in front of them- they introduced rather new approach in Serbia in regard to local budget in form of program budgeting.

3. BUDGET AND PUBLIC FINANCES

It is very often the case that budget and public finances are mixed in sense of terminology but also in sense of understanding what these terms actually represent. Unlike public finances, which represent public revenue collection and making expenditures, i.e. spending of public funds, budget is a detailed, annual, obligatory systematized plan of collection and spending of public funds for a certain period, usually for one year. The budget foresees and allocates public expenditure and revenue, connects them, as provided by law, in a rational and coherent system of public finance. However, the budget is a key mechanism in public finances and represents a financial expression of working programs of the national or local government for a given year.

Local governments, being the closest to citizens of all levels of government, should be able to recognize the needs of its citizens, and those needs should be reflected in local budgets. This would practically mean that citizens are included in decision making process and those decisions are then reflected through expenditure of finances, i.e. through local budget. This creates circle of trust among local administration and citizens, and ideally, willingness of citizens to pay even higher taxes if they understand what money is spent on and how it is spent.

4. LOCAL BUDGET AND CITIZENS' INVOLVEMENT

John L. Mikesell in publication of World Bank edited by Anwar Shah (2007) points out that "The citizenry is more inclined to accept increased tax payments when it sees a clear link between payment of the tax and improved government services. When taxes are levied and collected at the central government level, that link can be hard to see. Payments disappear into the national treasury, and the funds get used in ways that have little identifiable consequence or impact on the taxpayer. The relationship can be radically different in the local fiscal structure. The governing body levies a tax for local roads, for example: the tax is collected locally, the money is spent on the local roads, and the citizenry can see the link between the tax and the service" (p. 18). The same parallel can be drawn in process of creating a budget and participation of citizens. The more citizens are informed on budget and included in process of its creation, the more they will approve local decisions. In many cases, when local citizens were not included in process of budget creation, it has been the case that local decisions and work of local government has been obstructed. This situation is not favorable neither for local politicians nor for the citizens- it stops progress, local services can not be fully provided, dissatisfaction raises.

In last several decades in Serbia, it cannot be judged that citizens were fully and appropriately involved in process of creating of local budgets. Although the process was always public in the sense that it has been published on local web page, local authorities did not put too much effort in actual citizen participation in the process. This kind of attitude and approach, i.e. exclusion of citizens from the process, has been justified by complexity of the process, inability of citizens to comprehend complicated budget lines etc, and thus it has very often been judged that involvement of citizens will additionally confuse already challenging and demanding process. On the other hand, citizens did not show too much enthusiasm for the process, estimating their involvement will not change anything, either way.

Ebdon and Franklin (2006) point out why participation process is valuable: „ Participation can be very useful in educating the public about key trade-offs and gaining valuable input from citizens about their priorities and preferences. Working with them to make these connections encourages citizens to participate in a more knowledgeable fashion rather than simply demand that their fi re station or library remain open without tax increases or other service cuts" (p. 444-445).

Process of budget adopting without too much of citizen involvement could have occurred during times when no strategies were being prepared, and thus no citizen or participation of professionals and experts and their input was needed. But, the process of creating local strategies was imposed to Serbian local governments as a pre-requisite for entering EU, i.e. for accessing European pre-accession funds. In that line, involvement of citizens through public debates and public fora is mandatory during the process of strategies creation. In parallel to this, when citizens realized they can influence decision making process in their community, through participation in creating local strategic document and budget accordingly, situation changes in a positive direction.

5. STRATEGIC PLANNING AND PROGRAM BUDGETING

Strategic planning is an important tool for adjusting to a changing environment. This kind of planning provides a clear definition of priorities and it determines the best ways of using the resources necessary for effective and efficient development, which are always limited. As such, it allows local authorities to effectively deal with the problems of development and growth. Local governments that develop and implement their strategic plans, are in general, more successful in managing local development, especially if they create strategies through a participatory process that includes the participation of all relevant subjects in the planning of the future of the local community.

In its course to reform and improve public finance management, Serbia decided to introduce Program budgeting, initially planned for 2009. It was postponed for 2015 according to article 112 stipulated in the Law on the Budget System (2015). This rather new approach for Serbia puts emphasis on prioritization and optimization of expenditure, in order to encourage economic growth and the efficient delivery and quality services of the public administration. But, in order to achieve this, several preconditions need to be fulfilled, *as stated in Budget process in the Republic of Serbia: Deficiencies and recommendations (2014): "Therefore, the preconditions for establishing a more efficient and more effective budget process include adequate political support, development of human and operational capacities, as well as the adoption of a consistent reform agenda in accordance with the best international experiences and adapted to the Serbian conditions" (p. 1).* Here may lay the explanation why the process of introducing Program Budgeting was postponed for more than a few years than it was originally planned - it shows that human capacities and political will were missing for this process. It is important to stress here that Program Budgeting is a process within which involvement of different stakeholders is needed, which is then leading to more transparency and easier access to information when, where and why finances were spent. Transitional countries almost by rule tend to keep budgeting process away from public eye, which leaves them a lot of space for maneuvering with public funds.

Regardless of this, Serbia showed political determination to accelerate the process of introducing Program Budgeting. As a country, Serbia judged, as literature states, program budgeting to be an effective mechanism for the implementation of public finance reform process, since it enables better performance management of public administration, greater responsibility of the budget beneficiaries, at the same time establishing a stronger link between local budget, local priorities and the implementation of public policies. In addition, Program Budget brings a greater transparency in the process of expenditure of financial resources, but is also regarded as a transparent tool in process of satisfaction of the citizens' local needs.

Budget of a certain town or municipality is considered to be one of most important acts adopted by the local assembly. Having this in mind, the process of budget creation should be approached in a serious and systematic way and with sufficient resources. Poor or inadequate budget that is not in line with local needs and development directions is a major constraint for the local community. Out of this reason, it is of high importance to have program budget aligned with strategic priorities and documents of local community. Since local strategic documents should set medium and long-term outputs an a realistic manner, it is not surprising that *Guidelines for the program budget development (2014) say that "Program budget enables matching alignment of medium-term outcomes and allocation of budget funds in order to improve the management of public policy. Public policy is reflected in the program budget because the expenditures are directly linked with the implementation of the program, program activities and projects that that lead to achievement and fulfilment of public policy. Program budget includes objectives and performance indicators and therefore allows monitoring of results of the implementation of public policies. Budget beneficiaries are expected to submit information on their programs, activities, projects and objectives, and make decisions on the allocation of budgetary funds accordingly. The aim of this type of budgeting is to improve the efficiency and budget expenditures" (p. 10).* Having this in mind, it can be concluded that strategic planning and program budgeting should be viewed as two segments of one process, which processes are interlinked and determine one another. Strategic plan, as an output of strategic planning is a basis for preparation of program budget for a budget year and two following fiscal years.

Preparation and executing of the budget, accountability and transparency of the expenditure evolved over the years. *Vujović (2012) says that "Traditionally, governments did little to justify the use of budget funds. They only had to provide evidence that budget resources under their control were used in line with the prevailing laws, rules and standards. The traditional accountability ended with a simple proof of (cost and input) compliance" (p. 20).* Situation has changed drastically in last decades, and now citizens want to be better informed on how public budgets are spent, and if the budgets could be spent in a more efficient way. In order to satisfy this public demand, concept of Program Budgeting provides some of the answers to the demand, which includes, relatively new concepts for Serbia, such are outputs, performance indicators and performance measurement. *Vujović (2012) says that "In its modern meaning, performance measurement (PM) is predominantly focused on performance monitoring in the broader context of public sector accountability. Used in conjunction with appropriately designed performance indicators (PI), they form the core of modern PM/PI systems that play a pivotal role in the evolution of performance oriented budgeting systems" (p. 18). Vujovic additionally notices that "Initially, the demand for more robust PM/PI systems originated from a desire to improve the quality of the budget process and move from input based line budgeting to output (program) based and, ultimately, outcome focused budgeting. Now advances in developing better and more robust PM/PI systems contribute to the constantly evolving quality and transparency of the budget process, help improve the efficiency of public resources in providing goods and services, as well as enhance efficacy in achieving stated objectives (i.e. immediate, intermediate and final outcomes)" (p. 22).*

6. LINE - ITEM AND PROGRAM BUDGETS - MAIN DIFFERENCE

For several reasons it became obvious that line-item budget had to be replaced with a different concept. One of them is greater focusing on results (outcomes), and efficiency and efficacy i.e. demand of the citizens to be completely informed what tax money is spent on. Line-item budget in a simple manner provides information on expenditure but not on the effects of spending. *Gianakis and McCue notice that "In focusing on the funds expended in specific categories, the line-item format drives policy and efficiency considerations into the background. It centers budget deliberations on the cost questions, rather than on how the work is done or what ends are to be achieved" (p. 21).*

Even it is relatively easy to prepare line-item type of budget, which is why the process of program budget has been postponed in Serbia, this type of budget does not provide required information on budget beneficiaries, activities nor local government. It provides simple information on amount spent on salaries, capital outlay, maintenance, purchase of goods etc. It does not give the information of the effects of such expenditure neither of kind of services provided for citizens. This type of budget does not say how many children are enrolled in kindergartens, how many kilometers of roads are repaired or cleaned. In order to respond to these questions, and to have broader perspective of how and on what public finances are spent, expenditures in budget ought to be re-arranged through variety of programs/ program areas, focusing on expected outcomes.

6.1. Program and Performance Budget Approach

Mukdad (2013) says that "Many writers separate "performance budget" and "program budget" as in many ways the latter was an evolutionary stage of the former" (p. 90). The same author finds, as many others, that program and performance budget are two sides of different coin (p.90). In effort to define program budget, Mukdad says "In very simple words, the idea behind the program and performance budget approach is, first, to propose that money distribute—customarily—to different departments according to specific types of expenditure . . . (line item); be spent, secondly, according to the developed, detailed listing of all activities of the whole organization or department . . . (program); in order to perform –thirdly—a listing of specific work in return . . . (performance)" (p. 91). Henry (2013) says that "We call it Program/Performance Budgeting, but this kind of budget, more commonly is known as either a Program Budget, emphasizing its budgeting of discrete governmental operations, or a Performance budget, stressing its focus on agency efficiency and effectiveness ant their measurement. In reality, when it was introduced to the nation in mid-twentieth century, it did both, so we call it Program/Performance Budgeting and define it as a system of resource allocation that organizes the budget document by operations and links the productivity of those operations with specific budget amounts" (p. 235).
In the program budget expenditures are classified by objectives and goals (in form of outputs and outcomes), and not by economic classification - accounts (such as salaries, costs of communication, travel, maintenance, etc.), nor by the organizational classification (by budget beneficiaries, such as: city/municipal administration, preschool institutions, directorates, cultural institutions). The primary goal of a program is to improve the prioritization of budget spending. In addition, with the increased attention paid to the

performance of budget beneficiaries, this type of budgeting aims to increase the pressure on the budget beneficiaries to improve efficiency and effectiveness.

One of the major accomplishments achieved in perusing and implementing Program budget is that it shows reasoning behind expenditures and results that are achieved by spending public money. But to achieve that, long-term outcomes are required, which are expected to be previously prepared in local strategic documents. Instead of focusing on what local government spends, the program budget focuses on the expected results in providing services to citizens. In the program budget, revenues and expenditures are connected by multi-annual programs which are defined by the local government. Program budget identifies expected results of these activities, which is its main and most important difference in comparison to other budget types.
It has been the case in many local self-governments of Serbia that strategic priorities are set too high and too ambitious, without relying on financial analyses and capabilities. In many cases, they just stayed on paper, not being followed by sufficient financial means for their fulfilment. One of the benefits of introducing program budgeting in local governments in Serbia was that it clearly showed what are the strategic objectives that are realistic and achievable, and which ones are not reasonable. Hence, program budget can serve as a tool used for reassessment of local strategic objectives. *As Mukdad clearly noticed in his paper (2013), there are several pre-conditions for establishing program budget: (a) goal has to be clearly identified; (b) objectives in order to achieve goal need to be identified; (c), programs, subprograms and units serving each goal need to be developed and classified and finally (d) inputs, i.e. money, manpower, materials etc. for each of the programs need to be determined (p. 92).* If any of these preconditions are fulfilled, or they are not realistic, sensible or achievable, program budgeting will not serve its purpose and will not be functional.

7. SUSTAINABLE DEVELOPMENT AND PROGRAM BUDGET

Underwood, Hackney, and Friesner argue that "sustainable community economic development policies satisfy three specific criteria: ecological holism, community centeredness, and institutional legitimacy. Under ecological holism, ecosystems must be managed to provide a continuous flow of resources to support provisioning without altering the structure, composition, and function of local ecosystems. Under community centeredness, development creates employment at living wages to reproduce the local institutional structure of the community. Under institutional legitimacy, all members within a community have a fair opportunity to benefit from economic development, even though benefits will not be equally distributed" (p. 1113).
Very important element of sustainable development is by all means environment and its vulnerability. *Bets (2015) says "as the scarcity of our natural resources and the fragility of our environment becomes increasingly evident and present in the minds of business and community leaders, economic development must respond by incorporating sustainability into the profession. Communities that respond quickly to this shift will be better prepared for a global economy that defaults to a triple bottom line approach. However, economic developers do not need to become geologists or transportation planners to embrace sustainability. Economic developers know how to identify and support their region's or community's cluster industries, a skill set that is crucial to the sustainability movement. One important role economic developers can play is to encourage the sustainability community to keep business-oriented solutions at the forefront when trying to meet socially-conscious end goals" (p. 49).*

If we take a closer look at two last criteria in Underwood, Hackney, and Friesner paper, they can obviously be seen and reflected in program budget. Involvement of wider community in process strategic planning and later in designing program budget creates space for economic development. Not only knowledge and expertise of different stakeholders in certain area will lead to creating strategic goals in such a manner they will exploit local advantages in highest possible level, but it is to be expected that these strategic orientation is more realistic and easier to achieve. As previously said, program budget must rely on strategic directions of certain community, and these directions (outcomes) ought to be reflected in a budget. In case strategic objectives are set too high and in unrealistic manner, which has been the case in many Serbian local authorities, their achievement is put under question. In that context, public finances are spent on goals that are not achievable or are unlikely to achieve, creating very little space for improvement of local community. Having in mind very high unemployment rates in Serbia, there is no space for mistakes and perusing the goals that are not reachable. Since local advantages are taken into account in creating strategic goals, it is to be expected that striving towards achievement of goals will lead to, among other things, increased local employment. If an employment is raised, local tax collection is at a higher stage, and local budget is augmented. Bigger local budget means more investments locally (not only for further employment and investment) in better living conditions for its citizens. And finally, if citizens are involved in creating budget and have a say in the process, it is to be expected they will have a fair opportunity to benefit from economic development.

8. CONCLUSION

Although introduced and accepted as a notion in half of 20th century, Program budget is almost completely unknown concept in Serbia. It was imposed by "outside factors" and did not come as inner need to prioritize objectives, strive towards reachable goals and in that manner create better living conditions for Serbian citizens. It was inflicted into Serbian society as a precondition for process of EU integration and reaching EU funds. Additional pressure to introduce program budgeting in Serbia was put by awareness raising of the citizens and their need to be included in planning process of their community, but also the need for their voice to be heard when it comes to say when and on what tax payers' money is spent on. These two factors paved the road for introduction of program budgets in Serbian local self-governments.

Additional burden for success of this process was the fact that strategic goals set in local strategic documents are not compatible with possibilities of their financing, i.e. the volume of local budget. There is a lot of confusion in using and transferring set strategic objectives from existing strategic documents into program budget, since too ambitious strategic objectives in existing local strategic plans do not allow proper creation and executing of program budget.

Both these assumptions lead to a conclusion that additional time is needed for program budgets of Serbian local self-governments to be fully implemented. Strategic documents ought to be re-examined and prepared in a realistic and achievable manner. Additional period for Serbian society and local administration is required in order to fully understand importance significance of citizens' participation, realize that inclusion of various stakeholders in process of strategic planning can only be advantage and that preparation of program budget in accordance to achievable local strategic documents only creates opportunities for future development.

REFERENCES

Betts, N. (2015). Sustainable Economic Development as a Cluster Strategy. *Economic Development Journal*, *14*(1), 45-49.

Constitution of the Republic of Serbia (2006). Retrieved from http://www.paragraf.rs/propisi/ustav_republike_srbije.html

Ebdon, C, Franklin, A. L. (2006). Citizens Participation in Budgeting Theory. *Public Administration Review*, *66*(3), 437-447.

Fiscal Council of the Republic of Serbia (2014). Budget process in the Republic of Serbia: Deficiencies and recommendations, Retrieved from http://www.fiskalnisavet.rs/doc/eng/budget_process_in_the_republic_of_serbia.pdf

Gianakis, G. A., McCue, C. P. (1999). *Local government budgeting- A managerial approach.* Westport, Conn :ABC-CLIO.

Henry, N. (2013). *Public Administration and Public Affairs*, New York, USA: Pearson Education Inc.

Law on Budget System (2015). Retrieved from http://www.paragraf.rs/propisi/zakon_o_budzetskom_sistemu.html

Law on Local Self-Government (2007). Retrieved from http://www.paragraf.rs/propisi_download/zakon_o_lokalnoj_samoupravi.pdf

Ministry of Finance of the Republic of Serbia (2014). Guidelines for the program budget development

Mukdad, I. (2013). Comparative Budgetary Approaches in Public Organizations, *Research Journal of Finance and Accounting, 4*(15), 88-98.

Shah, A. (2007). Local Budgeting, Public Sector Governance and Accountability Series. The World Bank, Washington DC, USA.

The National priorities for international assistance NAD (2014-2017 with 2020 projections). Retrieved from http://www.evropa.gov.rs/Documents/Home/DACU/12/74/NAD%202014-2017%20with%20projections%20until%202020%20(english).pdf

Underwood, D.A, Hackney, D.D, & Friesner, D. (2015). Criteria for Sustainable Community Economic Development: Integrating Diversity and Solidarity into the Planning Process, *Journal of economic issues, 49*(4), 1112-1123. doi: 10.1080/00213624.2015.1105050

Vujović, D. (2012). A study on effective use of performance indicators in public sector and Budgeting and Planning- Designing Performance Indicators for Improved Budget Performance in Serbia. Belgrade, USAID Business Enabling Project.

HAS THE FINANCIAL CRISIS CHANGED THE RESEARCH AGENDA ON BANKING REGULATION AND SUPERVISION?

Jose Dias Lopes
Lisbon School of Economics and Management, University of Lisbon,
diaslopes@iseg.ulisboa.pt

Abstract: *The impacts of the financial crisis, which was developed from 2007, were many e very different. In this research we study those impacts in the research agenda on banking regulation and supervision. This study, performed from a 323 article sample, reveals a change in the published investigation's volume, evident after 2011. This situation indicates a time lag between the crisis outburst and the accomplishment of its growing interest for its inherent themes.This study also allows to testify a change concerning interest focuses, emerging themes such as: Politics, Basel-III (obviously), Systemic Risk and Regulatory Capture.On the opposite side, the Keywords associated to a Value-at-risk and to the second agreements of Basel, specifically, Basel-II, Basel Capital Accord and Market Discipline, lost some ground in literature.*

Keywords*: banking regulation and supervision; crisis; research agenda; regulation; keyword analysis; bibliometrics*

1. INTRODUCTION

The crisis, which has been installed in the world economies from 2007, is certainly going to be the most relevant economic and social fact of the beginning of this century. The crisis" dimension is frequently compared to the crisis which began in 1929, and which originated the long Great Depression. The 2007 crisis" exceptionality is also observed by the singularity of its associated occurrences, being them:

- The significant volume of support which the States had to ensure to the financial system, which corresponded to an effective use of €1.7 trillion, or 13 percent of EU GDP of government support to the banks between September 2008–December 2011 only in the European Union, according to the International Monetary Fund (IMF, 2013); or
- The society"s insecurity related to its banks, which has been materialized into a succession of bank runs or protests at their doors, which have been observed in Cyprus, Spain, Greece, Ireland, Portugal, United Kingdom, etc. For instance, according to Milne & Wood (2008), in 2007, the United Kingdom witnessed the first bank run with significant impact – The Northern Rock – since the reign of Queen Victoria (which ended in 1901).

This dimension and singularity of the financial crisis" events has led it to be felt and analyzed by the overall population. Therefore, the financial crises, besides the great value destruction at an economical level, and besides debilitating the bank system concerning financial stability, has also produced a collateral damage of great importance: it has significantly reduced the overall financial system and the banking system"s reputation in particular (see Jones, 2015, august, 25; or Rowe, 2012). The lack of confidence which has been installed related to the banking system is so prevalent that it has become a *cliché* (Springford, 2011). Confidence is not a disposable active of the financial system. On the contrary, as Singh & LaBrosse (2011) state, it performs a very important role in the system"s sustainability and, therefore, the current situation cannot stop having consequences in the definition of the collection of regulation solutions.

The idea that the regulation of the financial sector must be rethought does not deserve a great deal of protest. On the contrary, the need to reevaluate the process of regulation of the financial sector is relatively consensual, either amongst those who consider that the crisis is the result of excessive regulation (e.g.: Nichols et al. (2011) or Calabria (2009), either amongst those who consider that the crisis is the result of deregulation (e.g.: Stiglitz et al. (2009) or Chabrak & Gendron (2015)), in other words, the process of the financial markets" liberation based on the conviction that these could/should be self-regulated.

Could this appeal to reevaluate the process of banking regulation already find echo in the published investigation on this subject? Or, in a different way, could one talk about an investigation on banking regulation before and after the crisis? This is the main question of this paper, which will be answered through the analysis of the volume of the published investigation and the evaluation of the approached subjects.

2. METHODOLOGY

With this paper, it is intended to evaluate the evolution of academic production on banking regulation and supervision. In order to evaluate the published investigation, it is used bibliometric techniques. Frequently, these techniques provide a quantitate evaluation, through the counting of articles, and a qualitative evaluation through the analyses of Keywords. Similar studies in terms of goals and chosen method can be found in Romo-Fernández *et al.* (2013), Lee & Su (2010), Zhang *et al.* (2015) and Liu *et al.* (2012).

The study was divided in two parts. In the first part, it was evaluated the quantitate evolution of the published evaluation on banking regulation. In the second part, it was intended to analyze whether the crisis which began in 2007 caused changes concerning the most studied themes.

In order to perform the study, it was elaborated a sample of articles obtained through research of documents which contained the search key „Baking Regulation" OR „Banking Supervision" on the Topic Field (which in practical terms means that the research fell upon the following fields: Title, Abstract, Author, keywords and Keywords plus), on the Web of Science Core Collection of Thompson Reuteurs.

3. RESULTS AND DISCUSSION OF THE QUANTITATE ANALYSIS

The 323 articles of the original sample are classified in 40 different Web of Science categories. However, the majority of the articles is focused on five categories, presented in Table 1.

Out of the 323 articles of the original sample, 280 (86,69%) were classified into the five indicated categories. These 280 formed a subsample which will be named subsample(A).

Table 1: Sample articles by Web of Science Categories

Web of Science Categories	# of Articles(*)	% of articles(**)
Economics	162	50.15%
Business finance	123	38.08%
Law	42	13.00%
Political science	41	12.69%
International relations	26	8.05%
Subsample total (in the five categories)	280	86.69%

(*) Several articles are classified in more than one category.
(**) of 323 articles.
Source: Web of Science and self-made calculations.

In what concerns the years of publication, it is observed that the last years are the ones where a bigger number of articles is registered (see Table 2, 2nd column). The phenomena can have a specific component of the banking regulation theme or it can result from a global increment from newspapers and attached articles. In order to evaluated which of the two aspects is more significant to the verified growth, it was performed an auxiliary research, also on the Web of Science, with the same filters, and with the search key „Bank OR Banking". The obtained results were filtered, and only articles in the previously mentioned five Web of Science categories were considered. It was obtained a sample of 21,486 articles. This sample is comparable to subsample(A) (280 articles).

Table 2 presents the data of the last 25 years to the three collections of articles: the original sample on banking regulation and supervision (323 articles); the subsample of the latter in the five considered Web of Science categories (subsample(A)); and the unabridged sample of articles on Banking presented on the Web of Science in the five considered categories (21,486 articles).

As it is verified, there is an increasing evolution of the number of published articles, which is visible on any one of the three considered series. However, in the article samples on regulation/banking supervision (original and subsample), it is observed an additional increase of the published investigation after 2011 (2012 and the following), besides the already mentioned evolution.

Table 2: Comparison of the sample with the total of articles in the five WoS categories indicated in Table 1

Years	Articles (#323)		Articles (#280)		Articles (#21,486)	
Previous to 1991	8	2.48%	8	2.86%	3,274	15.24%
1991	1	0.31%	0	0.00%	187	0.87%
1992	2	0.62%	2	0.71%	286	1.33%
1993	3	0.93%	3	1.07%	286	1.33%
1994	6	1.86%	5	1.79%	343	1.60%
1995	4	1.24%	3	1.07%	349	1.62%
1996	3	0.93%	3	1.07%	385	1.79%
1997	2	0.62%	2	0.71%	390	1.82%
1998	2	0.62%	2	0.71%	451	2.10%
1999	4	1.24%	4	1.43%	537	2.50%
2000	7	2.17%	6	2.14%	508	2.36%
2001	7	2.17%	6	2.14%	466	2.17%
2002	6	1.86%	6	2.14%	507	2.36%
2003	8	2.48%	8	2.86%	512	2.38%
2004	11	3.41%	8	2.86%	530	2.47%
2005	9	2.79%	8	2.86%	549	2.56%
2006	11	3.41%	11	3.93%	687	3.20%
2007	12	3.72%	11	3.93%	705	3.28%
2008	15	4.64%	14	5.00%	957	4.45%
2009	16	4.95%	14	5.00%	1.026	4.78%
2010	19	5.88%	13	4.64%	1.078	5.02%
2011	19	5.88%	16	5.71%	1.286	5.99%
2012	33	10.22%	27	9.64%	1.401	6.52%
2013	36	11.15%	31	11.07%	1.549	7.21%
2014	38	11.76%	32	11.43%	1.605	7.47%
2015	41	12.69%	37	13.21%	1.632	7.60%

Source: Web of Science and self-made calculations.

In the graphic of Figure 1, the change of the publication pace after 2011 is evident.

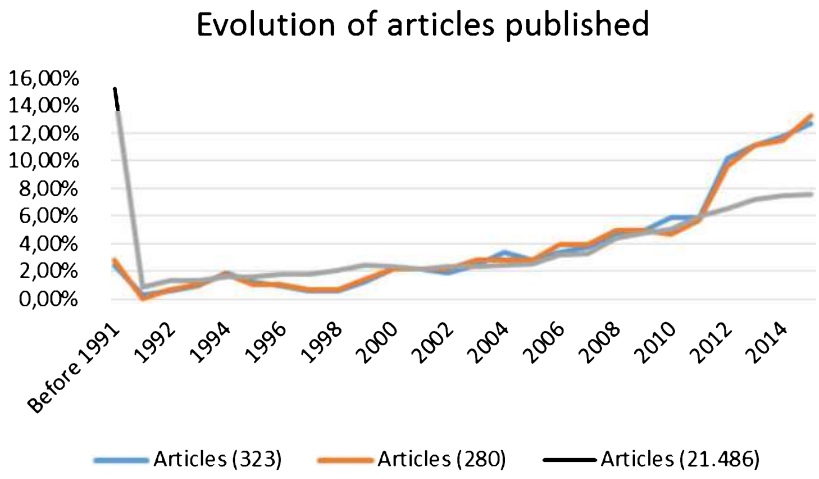


Figure 1: Evolution of the published articles
Source: Web of Science.

The increase of publications which is observed after 2011 results from the increment of investigation focused on studying the financial crisis. When one performs a research in the original sample (323 articles) and includes the expression „*Financial Crisis*" on the Topic field, one obtains the results presented in Table 3.

Table 3: Subsample of articles on the financial crisis

Years	Articles
2000	1
2003	1
2009	2
2010	1
2011	4
2012	8
2013	6
2014	12
2015	8
Total	**43**

Source: Web of Science.

With this new data, it became possible to have a better perception of the mentioned global evolution. The publication of articles which fall upon the financial crisis, practically inexistent before 2011, show a meaningful presence after that year.
Therefore, it can be affirmed that the investigation on banking regulation and supervision increased the pace of publication with the advent of the financial crisis. This increase can be associated to the outburst of lines of investigation precisely focused on the debate of financial crisis related matters. It is also observed that that increment is not immediate, mediating for about four or five years since the first indications of financial crisis, until a significant increase of the number of published articles becomes visible.
On one hand, this time lag is attributed to the design and research process and, on the other hand, to the process of elaboration, edition and article publication which was taking place.

4. RESULTS AND DISCUSSION OF THE KEYWORDS ANALYSIS

Out of the 323 articles of the original sample, only in 272 there were records of Keywords. Therefore, a subsample was built, constituted by these 272 articles (here on now named subsample(B)), which will be the object of study.

4.1. Characterization of the sample and description of the procedures

The number of registered Keywords (KW) was 2,172, which means 7.99 KWs per article, in the total of the subsample(B) (272 articles). The situation is very divergent throughout the sample, considering that the number of KWs per article presents a range from a minimum of one (in 14 articles) to a maximum of 21 KWS in one single article. The most frequent situations are 4 KW per article (in 28 occurrences); 6 KW per article (in 28 occurrences); 5 KW per article (in 26 occurrences); 7 KW per article (in 25 occurrences); 8 KW per article (in 24 occurrences); and 9 KW per article (in 19 occurrences).
There were identified 1,127 different KWs, being the three most frequent: Banking Regulation, which occurred in 82 articles, Banking Supervision, observed in 32 articles, and Deposit Insurance, which occurred in 23.
As it is frequent in these situations, it is convenient to perform an orthographic standardization of the KWs. This was done in a similar way to Lee & Su (2010) and Zhang *et al.* (2015). The performed standardization included the following changes in KW: (1) singular/plural standardization (e.g. from *Bank Failure* to *Bank Failures*); (2) standardization of the use of the hyphen (e.g. from *Basel-II* to *Basel II*); (3) standardization of orthographic variations (e.g. from *Crises* to *Crisis*; from *Basle II* to *Basel II*); (4) standardization of the use of the terms bank/banking (e.g. from *Bank Regulation* to *Banking Regulation*); (5) standardization of the use of abbreviations (e.g. from *BIS* to *Bank for International Settlements*). To fulfill these criteria, 63 KWs were standardized.
Besides the described procedures, 15 other standardizations were performed which allowed the elimination of another 28 KWs.

In the performed standardizations, the rule was always to choose the most frequent KWs.
This process led to repetitions of the same KW in the same article. There were registered 42 occurrences of this sort. These repetitions were eliminated, providing the result of a final list of 1,036 different KWs used 2,130 times.
After the standardization, it was elaborated a list of the most frequent KWs, presented in Table 5. On the first column, there is the KW"s code number; on the second there is the KW; on the third and fourth columns, the number of articles which possess that KW, in the period of time before 2012 and after 2011, respectively; and on the last column, the total of articles where the KW has occurred. This last column"s value was used to order the table.
While creating this KW list, it was established a thresholder. In other words, it is the line under which KWs stopped being considered for analysis. This thresholder was defined in eight articles, which means that the KWs which only occurred in seven or less articles were not considered for analysis.
The obtained list is composed by 43 different KWs (4.15% of the total of KWs), which were mentioned 680 times altogether (31.92% of the occurrences), in 237 articles (86.81% of the articles). If the thresholder were established at a lower number, seven for instance, it would implicate the analysis of more 12 KWs and the addition of only 5 new articles. The trade-off between the complexity of analysis and the KWs coverage of the sample articles justify the indicated value of the thresholder.
Some of the KWs do not add any value to the analysis, either because they only reflect the theme of the study (*Banking Regulation, Banking* or *Financial Regulation*), either because their meaning is related to aspects which are not the object of study (*EU* (European Union)). Therefore, the following KWs were not considered for analysis: Banking Regulation, Banking Supervision, Banking, Banks, Financial Regulation, Regulation, EU (European Union) and G21 (JEL code G21: Banks, Depository Institutions, Micro Finance Institutions, Mortgages.). The list of KWs for analysis was reduced to 35 KWs.
The number of articles of the subsample(B) posterior to 2011 (2012, 2013, 2014 and 2015) was 136, and 137 of all the period before (from 1991, when an article was registered for the first time, to 2011). This inclination is fruit of the already mentioned increase of publications over these more recent few years.
Since two values are practically equal, the incidence of KWs per article in each of the periods can be evaluated by the simple comparison of the number of articles belonging to a period of time and to the other.

Table 4: Most frequent Keywords

id.	Keyword	Before 2012	After 2011	Total
	Banking Regulation	**49**	**44**	**93**
	Banking Supervision	**15**	**19**	**34**
1	Capital Requirements	18	12	30
2	Crisis	5	23	28
3	Deposit Insurance	14	10	24
	Banking	**13**	**9**	**22**
4	Market	10	10	20
5	Risk	11	9	20
6	Models	8	10	18
7	Value-at-Risk	13	4	17
	Banks	**10**	**6**	**16**
	Financial Regulation	**1**	**15**	**16**
8	Politics	4	12	16
9	Basel III	1	14	15
10	Competition	5	10	15
11	Financial Crisis	2	13	15
12	Liquidity	8	7	15
13	Financial Stability	6	8	14
14	Information	4	10	14
15	Systemic Risk	3	11	14
16	Governance	6	7	13
	Regulation	**4**	**9**	**13**
17	Basel Capital Accord	11	1	12
18	Basel II	9	3	12
	EU	**4**	**8**	**12**
19	Banking Crisis	6	5	11
20	Management	7	4	11
21	Policy	3	8	11
22	Market Discipline	8	2	10
23	Risk-Taking	4	6	10
24	Central Bank	5	4	9
25	Commercial-Banks	4	5	9
26	Economic-Growth	3	6	9
27	Globalization	4	5	9
28	Regulatory Capture	0	9	9
29	Basel Committee on Banking Supervision	4	4	8
30	Credit	4	4	8
31	Determinants	0	8	8
32	Financial Intermediation	3	5	8
	G21	**3**	**5**	**8**
33	Monetary Policy	2	6	8
34	Risk Management	5	3	8
35	Securitization	2	6	8

Source: Web of Science and self-made calculations.

4.2. Analysis of the results per KW

In this section, it will be performed the analysis of each one of the 35 most frequent, meaningful KWs to this study. Throughout all the analysis, all the investigation published until 2011 inclusive will be considered pre-crisis academic production. And the investigation published after 2001 will be considered post-crisis academic production, accordingly to what has been stated in previous sections of this paper.

While comparing the pre and post-crisis academic production, the occurrences in which there are 75% or more of the articles where a KW is particularly used in a period of time will be pointed out.

Figure 2 summarizes the obtained results. It shows the 35 most frequent KWs. Some KWs are pointed out in a particular way because they:

- **Have gained importance** over the last few years (pointed out in Bold with a solid line around it, and with an arrow (➔) before the KW;
- **Have lost importance** over the last few years (pointed out in italic with the mark (**X**) before the KW).

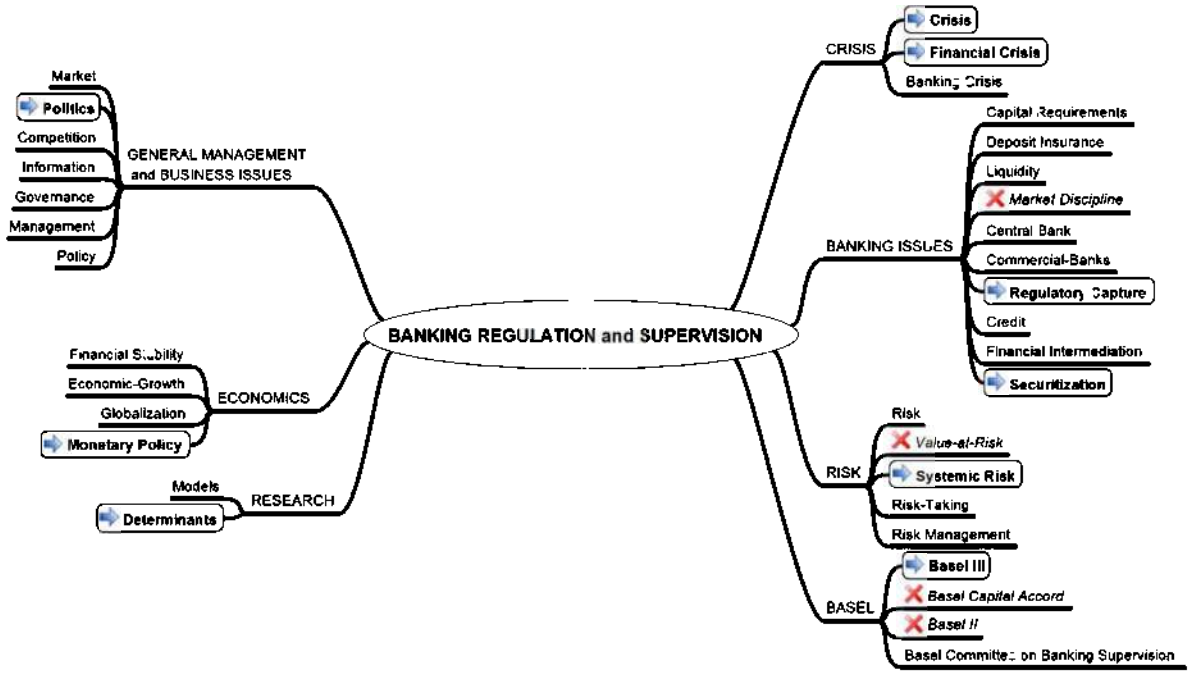


Figure 2: The Keywords map on banking regulation and supervision

This Figure could be seen as the genetic map of banking regulation and supervision. As it can be verified, recent changes in some "genes" were pointed out, as a result of changes in the "environment" in which regulation is produced and developed. Time will tell if these changes correspond to lasting mutations or just momentary adjustments; if the changes are only circumscribed to the signaled ones or if other "genes" will change as well.

A final note, not related to the presented KWs, but related to the absences or barely approached themes.

The study allowed the identification of various theme collections, whose KWs have been dominating the literature, such as: Banking issues, Risk, Basel; Crisis, Economics, Management and Research. The most surprising fact is the absence of a collection on one of the themes of banking regulation, where perhaps it could be included *Market Discipline*, *Regulatory Capture* and, for instance, *Moral Hazard* (related to this subject, the following KWs were registered: *Dynamic Moral Hazard* (once), *Moral Hazard and Bank Supervision* (once), and *Moral Hazard* (six times)) or *Self-regulation* (when it comes to this theme, there have been identified the following KW: *Enforced, Self-Regulation, Market Self-Regulation and Self-Regulation* (there is only one single occurrence for each of them), or where it could be discussed the meaning of new institutions to banking regulation, such as the Financial Conduct Authority in the United Kingdom or the already mentioned Consumer Financial Protection Bureau in the USA.

5. FINAL CONSIDERATIONS

In this paper, it was evaluated the evolution of the recent investigation on banking regulation. For that, it was analyzed the volume of production and the used KWs in published articles on the theme. The study shows a growth on the published investigation, which is evident after 2011. This indicates the existence of a time gap,

of about four or five years, between the first signs of the phenomena (crisis) and the boom of publications where the phenomena is already an object of study.
Concerning the frequency in the use of KWs, it was established a stable core of 35 most used ones. These KWs are considered to describe well the majority of the published investigation on the theme. On this most frequent KWs list, a change concerning interest focuses is verified, emerging themes such as: *Politics, Basel-III, Systemic Risk* and *Regulatory Capture.* On the opposite side, KWs associated to *Value-at-risk,* to the Basel accords, particularly, *Basel-II, Basel Capital Accord,* and *Market Discipline* lost some ground in literature.
The analysis proves the importance of the Basel Accords and the centrality of BIS in the process of developing banking regulation. Besides this central importance of BIS, the following were also pointed out as relevant strands:

- Banking nature, where it is possible to stand out themes such as Capital Requirements, Deposit Insurance, Risk (several dimensions), Liquidity, Credit and Securitization:
- The economical one, which includes Financial Stability, Economic-Growth, Globalization and Monetary Policy;
- Business and Management, where it is possible to find themes such as Market, Competition, Information, Governance and Management.

In order to answer the question asked in the beginning of this paper, one can, in fact, observe changes either quantitate, either in contend in the publish investigation on banking regulation and supervision before and after the crisis.
For the last decades, banking regulation has suffered profound changes. The agenda on the process of implementation of these changes, the evaluation of their impact and the establishment of new ways towards regulation were, on a large scale, defined by regulator forums or institutions of a similar nature. In this debate, the academy appeared many times to be more reactive than proactive. As a consequence, its research agenda frequently reflected themes and subjects established in other forums and other institutions. It is important to the academy to recover the role of a relevant player in the debate on banking regulation, because only the academy can provide to this debate the only contribution which derives from the diversity of points of view which exist within it, and from the autonomy with which these points of view can be expressed.

REFERENCES

Calabria, M. (2009) Did Deregulation Cause the Financial Crisis? *Cato Policy Report*, XXXI (4 (July/August 2009)): 5-8.

Chabrak, N., & Gendron, Y. (2015) Promoting research from the “periphery”: Engaging critically with the Global Financial Crisis. *Critical Perspectives on Accounting*, 30: 1-8.

IMF (International Monetary Fund) (2013) *European Union: Publication of Financial Sector Assessment Program Documentation-Technical Note on Progress with Bank Restructuring and Resolution in Europe*. IMF Country Report No. 13/67. Washington, D.C.: International Monetary Fund.

Jones (2015, 28 de Agosto) *Ratings of U.S. Banking Industry Level Off*. Gallup Poll Social Series. Gallup. Available at: http://www.gallup.com/poll/184916/ratings-banking-industry-level-off.aspx. (accessed on 10/01/2016).

Lee, Pei-Chun & Su, Hsin-Ning (2010) Investigating the structure of regional innovation system research through keyword co-occurrence and social network analysis. Innovation, 12(1): 26-40.

Liu, Xingjian; Hong, Song and Liu, Yaolin (2012) A Bibliometric Analysis of 20 Years of Globalization Research: 1990–2009. Globalizations, 9(2): 195-210.

Milne, A., & Wood, G. E., (2008) Banking crisis solutions old and new. *Federal Reserve Bank of St. Louis Review*, Sep: 517-530.

Nichols, M. W., Hendrickson, J. M., & Griffith, K. (2011) Was the financial crisis the result of ineffective policy and too much regulation? An empirical investigation. *Journal of Banking Regulation*, 12(3): 236-251.

Romo-Fernández, L. M., Guerrero-Bote, V. P., & Moya-Anegón, F. (2013) Co-word based thematic analysis of renewable energy (1990–2010). Scientometrics, 97:743–765.

Rowe, O. (2012) *Case Study. Reputation of Banking*. Case Study. YouGov. Available at: http://cdn.yougov.com/cumulus_uploads/document/tlgxb3zoa8/Reputation_case_study.pdf. (accessed on 10/01/2016).

Singh, Dalvinder & LaBrosse, John Raymond (2011) Developing a Framework for Effective Financial Crisis Management. *OECD Journal: Financial Market Trends*, 2011(2): 1-30.

Springford, J. (ed.) (2011) *A confidence Crisis? Restoring trust in financial services*. London: Social Market Foundation.

Stiglitz, J., Bougrov, A., Boutros-Ghali, Y., Fitoussi, J. P., Goodhart, C. A., Johnson, R., ... and Persaud, A. (2009, September) *Report of the Commission of Experts of the President of the United Nations*

General Assembly on Reforms of the International Monetary and Financial System. In UN Conference on the World Financial and Economic Crisis and its Impact. New York: United Nations.

Zhang, Wei; Zhang, Qingpu; Yu, Bo & Zhao, Limei (2015) Knowledge map of creativity research based on keywords network and co-word analysis, 1992-2011. Quality & Quantity, 49(3): 1023-103.

AN APPLICATION OF NEURAL NETWORKS AND FUNDAMENTAL ANALYSIS FOR AUTOMATED TRADING: BELGRADE STOCK EXCHANGE CASE

Aleksandar Rakićević*[1], Ana Milovanović[1], Rastko Aničić[1]
[1]Faculty of organizational sciences, University of Belgrade
*Corresponding author, e-mail: aleksandar.rakicevic@fon.bg.ac.rs

Abstract: *This research demonstrates an application of neural networks for automated trading using fundamental analysis on Belgrade Stock Exchange. Our main goal is not to try to predict stock prices, but rather to determine whether the process of stock market trading can be learned and performed by artificial neural network with a positive outcome. In order to train the proposed feed-forward network mechanism for market trading we use fundamental analysis ratios as inputs, while the output is a trading signal. Further, we incorporate the proposed artificial neural network into a virtual trading machine, created for the purpose of trading simulation. We test the proposed approach on the stocks from Prime Listing of Belgrade Stock Exchange.*

Keywords*: automated trading, fundamental analysis, neural networks, Belgrade Stock Exchange.*

1. INTRODUCTION

Automated trading represents a special type of trading on financial markets where a computer program or another kind of automated system is used to collect data, analyze it, make trading decisions and execute trading orders on the market. This area of finance has arisen since the end of 1980s when first fully electronic communication and execution networks were developed in financial markets. Since then, it has been developing rapidly following the expansion of information and communication technologies. Automated trading become very popular in 2000s, reaching almost 75% of total market trading volume in 2009 (Kissel, 2013).

There are two common forms of financial analysis: fundamental and technical analysis. Main focus in this research will be on the fundamental analysis and its ability to suggest the possible profitable stocks. Fundamental analysis is the cornerstone of investing. Its largest part involves delving into the financial reports. It utilizes quantitative tools, mainly the financial ratios, as well as other indicators such as management policy, marketing strategy and product innovation to determine the value which can be compared with a stock's current price (Lam, 2004).

This research represents the extend of the previous studies in a way of further use of ANNs as a trading tool. In this study, we developed a system for automated stock market trading. The proposed system combines fundamental analysis and neural networks to create a trading algorithm used for investment decision making. We use feed-forward network as well-known and most commonly used ANN structure. Fundamental analysis is used to obtain learning inputs, which are used by the ANN to understand the underlying process of the market. To obtain learning outputs we extract the historical trading signal using a ZigZag indicator of trend. Further, we create a virtual trading machine in order to simulate real market trading and test the proposed system. The proposed system is tested on BSE stock market data.

The remainder of this research is organized into four sections. In the next section we present the literature review. Section 3 describes the proposed methodology. In section 4 we present data, trading settings, trading signal extraction method and final results and discussion. The last, fifth section concludes the paper and provides further research suggestions.

2. LITERATURE REVIEW

ANNs have been widely used for financial research, especially in financial market forecasting. In their extensive research on soft computing techniques for financial forecasting, Atsalakis and Valavanis (2009) gave an considerable review of neural and neural-fuzzy techniques. Their review showed that feed-forward networks are the most commonly used networks for financial forecasting, including one-third of all surveyed articles. The most likely reasons for this are the simplicity, seed and their easy implementation. Further, the

review also showed that authors mostly use networks with one or two hidden layers. Long ago, Bishop (1994) has shown that there is no need to consider more complex structure since the ANN with one hidden layer has universal approximation capabilities.

Even though ANNs were extensively used for financial forecasting for more than 30 years, long time passed until authors started to use their forecasting power within the automated trading systems. Several authors tried to use ANN in combination with fundamental analysis in order “to beat” the market or some well known investment strategy. Eakins and Stansell (2003) used simple feed-forward structure with 2 hidden layers (6 and 3 nodes) and backpropagation learning algorithm to enhance the process of stock selection. In order to train their ANN to learn to pick stocks they use fundamental valuation ratios. Testing their system on more than 20 years of stock market data they conclude the ANN consistently outperformed 7 benchmark portfolios, among them both S&P 500 and Dow Jones Industrial Average market portfolios. Later, Krishna *et al.* (2010) replicated their research methodology on Bombay stock exchange and confirm their findings.

Olson and Mossman (2003) used ANN to forecast one-year-ahead Canadian stock returns based on 61 accounting ratios. Further, they built a trading strategy that converts these forecasts into portfolio holdings. Finally, they compare the proposed ANN approach with ordinary least squares (OLS) and logistic regression (logit) approaches. They conclude that simple backpropagation network can outperform best regression alternatives in forecasting, which translated into greater profitability of the trading strategy. Vanstone et al. (2012) used ANN with Aby’s filter, which incorporates 4 fundamental ratios, to create an automated trading system for the Australian stock market. Their results showed the proposed approach performs well in terms of profitability, but experienced high volatility of returns. Another important paper is the one written by Vanstone and Finnie (2009), who presented a methodology for designing and testing stock market trading systems using ANNs.

3. TRADING SYSTEM

In this research we propose an automated trading system for stock market trading. It is a complex system consisted of two components (Figure 1). The first component is used for pre-processing of stock market data. It consists of two sub-components, one for fundamental analysis and the other one for trading signal extraction. The second component represents the trading logic and is used for investment decision making. It consists of artificial neural network and the trading algorithm. The purpose of ANN is to use fundamental data to forecast trading signal which is used by trading algorithm to generate trading orders.

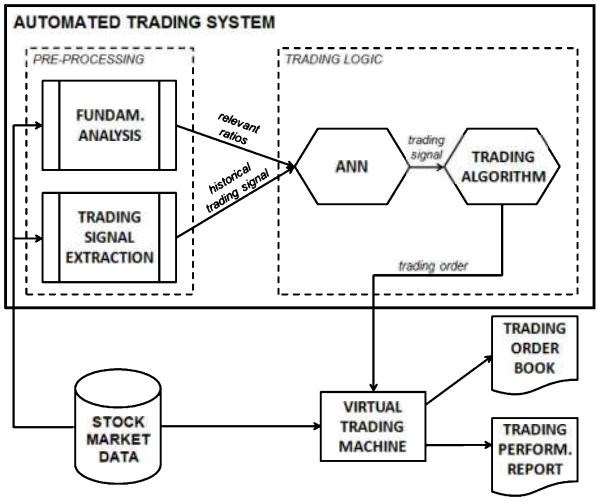


Figure 1: Automated trading system structure

3.1. Artificial neural network

The term "network" is used to refer to any system of artificial neurons. This may range from something as simple as a single node to a large collection of nodes in which each one is connected to every other node in the net. Each node first aggregates its input in a linear manner using simple weighted sum and then use activation function to make nonlinear relation between input variables and nodes output. Nodes are arranged in a layered structure, and each layer can be consisted of one or more nodes.

In this study we use the feed-forward network structure, which is the oldest and simplest type of ANN. In this network, information moves only forward and there are no loops. Each input signal has to pass through all hidden layers before reaching the output layer. To train our network we use backpropagation learning mechanism.

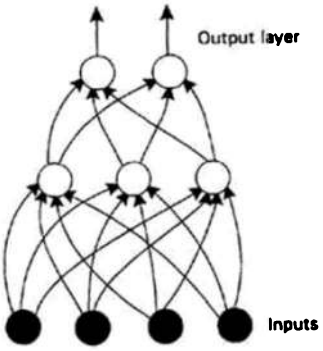


Figure 2: Neural Network architecture (Gurney, 1997)

It is important to notice that our network use tan-sigmoid function as activation function. Tan-sigmoid has the following formula:

$$\sigma(n) = \frac{2}{1+e^{-2n}} - 1 \tag{1}$$

As Gurney (1997) suggests, it is typically used when input pattern needs to be classified into one of several classes. In the case of our trading system, output variable represent trading signal which has three classes: buy, hold and sell. The signal can take all numeric values between -1 and +1, which also perfectly corresponds to tan-sigmoid function (Fig. 3).

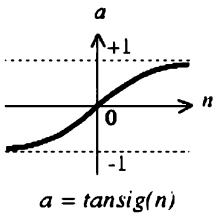


Figure 3: Tan-sigmoid function graph

Trading does not start when the system activates. Certain number of observations must be analyzed, which are used as initial trading set. Network then uses the set in order to learn underlying model of the market. Input parameters for the network are ratios gathered from the fundamental analysis. Additionally, NN uses historical trading signal extracted from special preprocessing component. When trained on initial set of data, NN starts predicting trading signals which are then sent to the trading algorithm component. It does so until actual trend changes. System then stops trading and activates retraining of neural network. Furthermore, it is retrained using all observations from the beginning until the change of trend.

3.2. Fundamental analysis

Within the fundamental analysis sub-component we use three well-known valuation ratios: price-per-earnings (PE), price-per-sales (PS) and price-per-book (PB) ratios. First of them, PE is measuring the current share price relative to its per-share earnings:

$$PE = \frac{Market\ value\ per\ share}{Earnings\ per\ share}. \tag{2}$$

Secondly, the PS is an indication of the placed value on each monetary unit of a company's sales or revenues:

$$PS = \frac{Stock\ price}{Revenue\ per\ share}. \tag{3}$$

Finally, the PB value compares the stock's market values to its book value:

$$PB = \frac{Stock\ price}{Book\ value\ per\ share}\ . \tag{4}$$

3.3. Trading signal extraction

In order to learn ANN to trade based on fundamental ratios we need to provide a trading signal as the output variable. We extract trading signal from trend data obtained using modified version of ZigZag indicator. The indicator is constructed using a general definition of trend: a tendency in data that creates a positive or a negative change in data level over certain period of time. Hence, the two key parameters of a trend are its time duration and the size of the underlying change. The indicator track these two parameters measuring the change in price and duration of that change from the previous maximum/minimum value. If both parameters cross the threshold values, indicator changes its direction.

Fig. 4 shows an example of trend extraction using two sets of different threshold values on the same data set. As it can be seen from the graph, the smaller the threshold values are, the indicator is more sensitive to changes in price. Therefore, the extracted trend data will depend on the choice of threshold values.

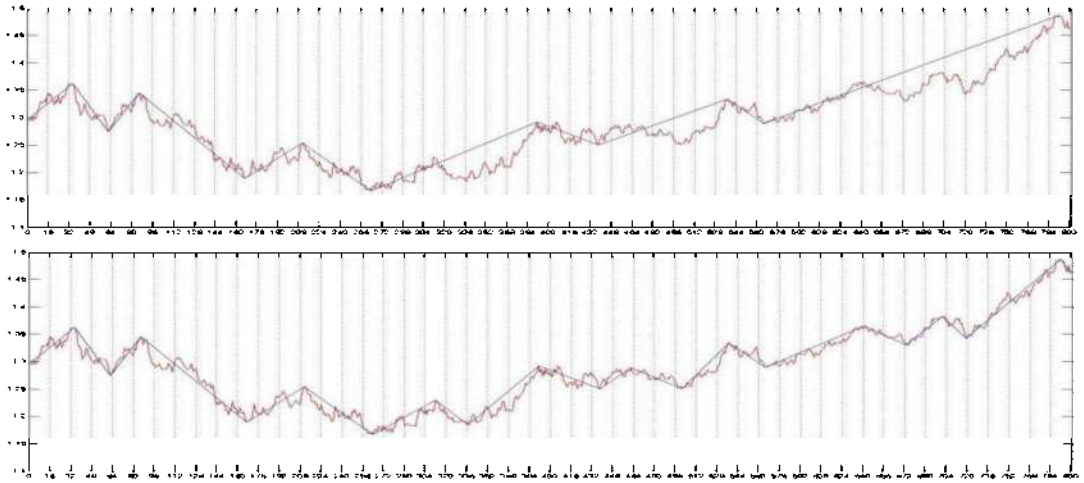


Figure 4: An example of trend extraction using modified ZigZag indicator with different threshold values

Further, to extract the trading signal we use simple linear transformation which transforms trend data into time series of values between -1 and +1. These extreme values are associated to reversal points in trend data. When trading signal takes value -1 it means that one should sell the instrument, while the opposite stands for +1.

3.4. Trading algorithm

Trading algorithm starts working when receives the forecasted trading signal from ANN. If the signal is negative and is bellow the determined threshold value, the algorithm sends buying order to the virtual trading machine. On the other hand, when signal is positive and above the determined threshold value, the trading algorithm issues the selling order. Trading algorithm separates the trading account value into several lots, which are calculated as the certain percentage of the current account balance. Trading algorithm keeps purchasing/selling stocks until all the lots are spent. Transaction costs are incorporated into trading orders to accomplish more realistic approach.

3.5. Virtual trading machine

The main purpose of the virtual trading machine (VTM) is to simulate stock market trading by using the real prices from the BSE. VTM manages trading orders received from trading algorithm, charges trading commission, takes care about currency and equity accounts, records transactions and calculated performance measures. Finally, when the trading simulation is done, VTM delivers the trading report which indicates how successful the trading system was.

4. RESULTS

The results of our research presented in this section are based on real stock market data. Summary results are presented in Table 3, while the individual results are discussed separately in chapters 4.4.1 to 4.4.4.

4.1. Data

As mentioned before, the proposed system has been applied on BSE stock data. Companies from Prime Listing, which is the most attractive market segment on BSE, has been selected for testing purpose. The selected companies are: „Aerodorm Nikola Tesla“ (AERO), „Energoprojekt holding“ (ENHL), „Naftna industrija Srbije“ (NIIS) and „Sojaprotein“ (SJPT). Official financial statement data are used to calculate necessary fundamental ratios used as input data to our neural network. Our dataset consists of data from different time frames, which are presented in Table 1. The price and financial statement data were obtained from official BSE website.

Table 1: Stock market data used in this research

Company	Start date	End date	Number of observations
AERO	7.2.2011.	31.12.2015.	1237
ENHL	1.10.2005.	31.12.2015.	2768
NIIS	23.8.2010	31.12.2015.	1349
SJPT	3.3.2008.	31.12.2015.	1979

The selected companies are the leading companies in different sectors. Different industry branches were used in the research to determine whether the trading algorithm is universal and suitable for application in opposite industries. For instance, NIIS is one of the largest vertically integrated energy companies in Southeast Europe. Its principal activities are exploration, production and refining, sales and distribution of a broad range of petroleum products, as well as the implementation of energy projects (NIS Official Website). Furthermore, SJPT is the largest soybean processing factory in Serbia, and thanks to the diversity, quality of its products and a processing capacity, it is ranked among the most important soybean processors in Central and Eastern Europe (Sojaprotein Official Website). In addition, AERO is the largest regional (Western Balkan) airport. Finally, ENHL is one of the leading construction companies in Serbia, withmain focus on research and development, consulting and engineering, construction and designing. (Energoprojekt Official Website) As a result, the inputs into the ANN are calculated daily ratios and close prices of all the previous companies.

4.2. Experimental settings

In order to test the proposed approach we use the following thresholds: duration threshold of 10 days and price change threshold of ±15%. Further, ona eventully eed-forward structure with one hidden layer consisted of 15 neurons has been implemented.

Virtual trader initial account balance is 1.000.000 monetary units. Having in mind that the trading strategy is used on BSE, we can assume that currency is Serbian Dinar (RSD). One trading lot used in this research equals 10% of the current account balance. Trader keeps purchasing stocks until the account is spent. Trading fees were introduced to the algorithm to accomplish more realistic approach. Trading fee equals 0.5% of the transaction value, which has exceeding resemblance to the one in realistic market. Fees are calculated both in short and in long positions opened. Trading regulations of Belgrade Stock Exchange forbid entering the short position.

Table 2: Automated trading system parameters

Parameter	Value
Initial account balance	1.000.000
Initial lot size	100.000
Trading fee	0,5%
Trading signal	±1
Duration threshold	10 days
Change threshold	±15%
Hidden layer size	15 neurons

4.3. Performance measures

Profit/loss (P/L) and return on investment (ROI) are relevant indicators on the precision of algorithm's trend recognition. Profit factor indicates the number of monetary units earned per ones spent. It takes values from interval (0;+∞). Values above 1,00 indicate that the final account balance is greater than the initial one, while values below 1,00 specify the opposite. Maximal drawdown represents the absolute difference between highest and lowest account balance values. Average profit per trade indicates illustratively virtual trader's successfulness.

4.4. Results and discussion

Table 3 presents summary results. Output parameters are listed along with the trading companies. Parameters are divided into three clusters. First one is regarding the total number of trades while the other two indicate on long and short trades committed respectively.

Table 3: Summary of trading results

Indicator/Company	NIIS	AERO	ENHL	SJPT
Total Trades	9	5	20	10
Trades won	44,44%	80,00%	35,00%	40,00%
Net profit	270.260	2.016.597	-715.474	127.093
ROI	27,03%	201,66	-71,55	12,70
Profit factor	1,62	13,37	0,23	1,17
Max. drawdown	-15%	-14%	-34%	-40%
Avg. profit per trade	30.029	403.319	-35.774	12.709
Long trades won	25%	100%	40%	40%
Long trades avg. profit	12591.65	798042.97	-18111.61	1.16
Short trades won	60%	66.67%	30%	40%
Short trades avg. profit	45527.2561	143661.02	-53361.85	15405.26

Total number of trades can imply on how dynamical the strategy is. The least dynamical was AERO, which was expected because of its business field. During the whole business year, airport activities are evenly distributed. That is why only 5 transactions were opened and, what is more, 4 out of 5 successful ones. The most dynamical was ENHL with 20 trades, which means that the algorithm has recognized trend variation approximately 20 times. Being a construction company, ENHL gains profit seasonally by project agreements. That is why there were many oscillations on the stock market and is quite hard to *pick up* the right trend line opportunely. As expected, ENHL total profit factor is below 1,00 and announces that the trading environment is turbulent and not likely predictive. The next two clusters represent some of the mentioned indicators, only separate long from short trade positions. Figures 6 to 9 more intuitively show the indicators.

Upcoming figures represent results of data testing. Each figure is consisted of three subplots. Topmost shows the closing price for every trading day from the beginning of the trading observations to the end of year 2015. The artificial neural network has been trained to recognize short and long position signals. The behavior of the trader will depend on the signal given, which is shown on the second subplot, and finally, the third subplot represents response to the signal.

4.4.1. AERO

The account balance is showing a significant growth and eventually, considerable profit. Despite the backward learning, trader correctly interpreted the signals on the account balance and the positive economic performance proves the accurately given signals.

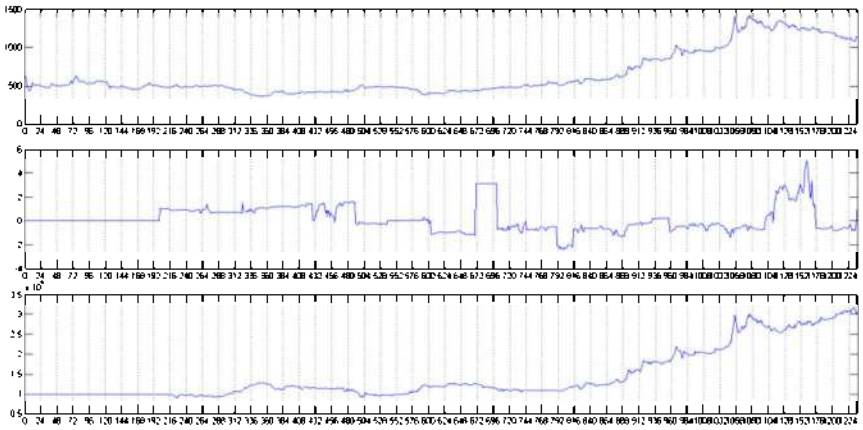


Figure 5: AERO Trading results

4.4.2. ENHL

The following Figure 6 presents the graph with trading results for ENHL. The figure presents the account balance is showing increase in the beginning and then the momentous fall at the end. Final results suggest that neural network is unable to read the market behavior.

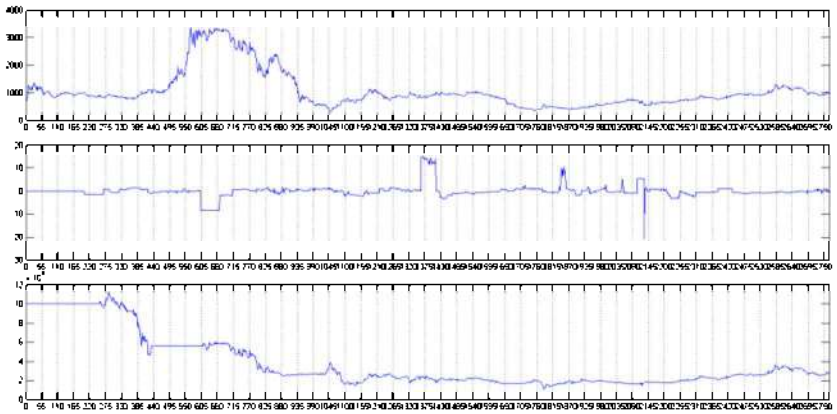


Figure 6: ENHL Trading results

4.4.3. NIIS

In NIIS example, neural network trades with variable success, but mostly profitable. This is an example of successful learning process in which neural network is able to discover underlying market fundamentals.

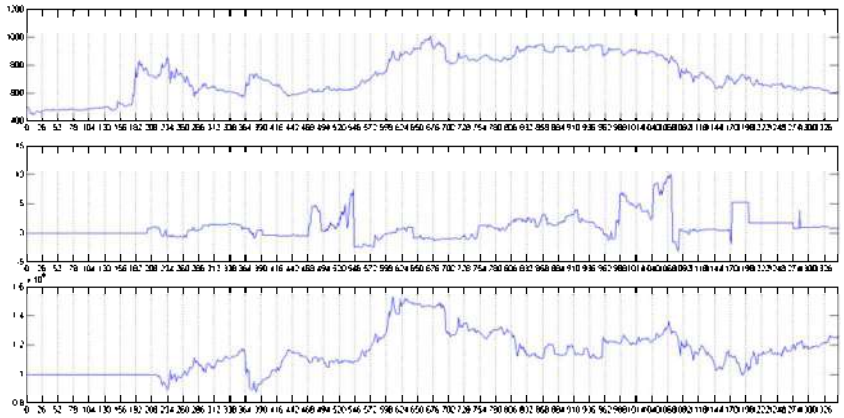


Figure 7: NIIS Trading results

4.4.4. SJPT

SJPT is tested using relatively longer time series within our sample. The obtained results are not very good, indicating the network is not a stable solution. The system starts well, but in some point become very unprofitable. Finally, very close to the end of test period it regain its profitability and recover losses.

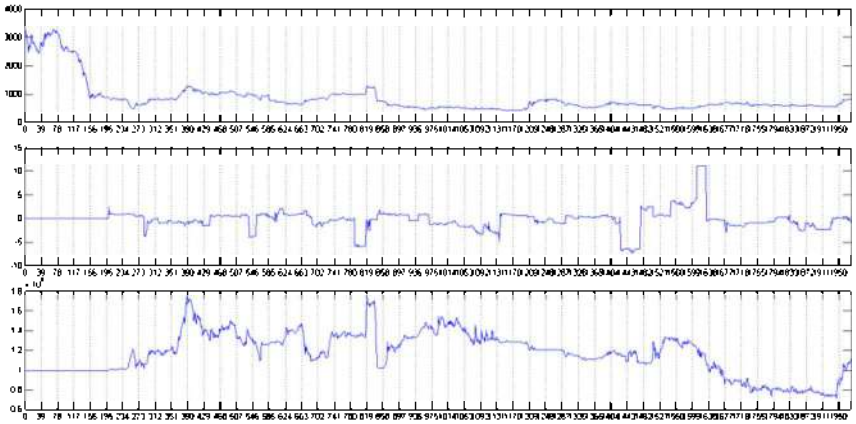


Figure 8: SJPT Trading results

5. CONCLUSION

In this research, the information available in the financial market were gathered and the variables that drive stock prices were taken into account. On the basis, of the fundamental analysis, the calculation of the investing ratios has been made. Thus, the neural network parameters consist of the data from official financial reports from companies of different sectors.Having in mind the results, it is possible to apply neural network algorithm to Belgrade Stock Exchange and obtain satisfying results. However, the network has not provided us with the wanted results in more turbulent trading environment. ENHL's stocks prices are vaguely foreseeable and neural network was not able to predict its trend in the right time. It was always *one step behind.* Moreover, that total account balance was positive in 3 out of 4 trading attempts;therefore, it is acceptable to say that the trader performed well overall and that the algorithm is applicable but not completely accurate.

To conclude, by using the real data to evaluate the trading signal neural network may show satisfying results on the data given with a room for improvement. The neural network tested in this paper has been using fundamental data and closing price generated every day on the stock exchange. It was applied only once on each dataset. To gain more accurate results, network should be executed for at least one thousand times, so that the middle value could be extracted. In that way, more relevant results could be gathered. To further improve its performance, a neural network should be using more complex algorithm. Therefore, the next step is to train a neural network to behave with a positive outcome in more complex environment as well as with more sophisticated algorithm. The step further is to demonstrate its performance on expanded stock market data. Besides that, the methodology presented may also be adapted to other enterprises and their stocks. This is the future research direction.

REFERENCES

Atsalakis, G. S., & Valavanis, K. P. (2009). Surveying stock market forecasting techniques–Part II: Soft computing methods. *Expert Systems with Applications*,*36*(3), 5932-5941.

Bishop, C. M. (1994). Neural networks and their applications. *Review of scientific instruments*, *65*(6), 1803-1832.

Eakins, S. G., & Stansell, S. R. (2003). Can value-based stock selection criteria yield superior risk-adjusted returns: an application of neural networks.*International Review of Financial Analysis*, *12*(1), 83-97.

Gurney, K. (1997). *An introduction to neural networks*. CRC press.

Kissell, R. (2013). *The science of algorithmic trading and portfolio management*. Academic Press.

Kumar, K. M., Subramanian, S., & Rao, U. S. (2010). Enhancing Stock Selection in Indian Stock Market Using Value Investment Criteria: An Application of Artificial Neural Networks. *IUP Journal of Accounting Research & Audit Practices*, *9*(4), 54.

Lam, M. (2004). Neural network techniques for financial performance prediction: integrating fundamental and technical analysis. *Decision Support Systems*,*37*(4), 567-581.

Olson, D., & Mossman, C. (2003). Neural network forecasts of Canadian stock returns using accounting ratios. *International Journal of Forecasting*, *19*(3), 453-465.

Vanstone, B., & Finnie, G. (2009). An empirical methodology for developing stockmarket trading systems using artificial neural networks. *Expert systems with applications*, *36*(3), 6668-6680.
Vanstone, B., Finnie, G., & Hahn, T. (2012). Creating trading systems with fundamental variables and neural networks: The Aby case study. *Mathematics and computers in simulation*, *86*, 78-91.

PERFORMANCE OF EVENT-DRIVEN HEDGE FUNDS' STRATEGIES

Vesna Bogojevic Arsic
Faculty of Organizational Sciences, University of Belgrade, Serbia
Corresponding author, e-mail: bogojevic-arsic.vesna@fon.bg.ac.rs

Abstract: In our days hedge funds represent the fastest growing group within the alternative investment. The hedge funds are usually defined by the investment strategy they implement. There is variety of different hedge funds" investment strategies. Having in mind, the consistency and use of different hedge funds" classification, the paper was based on HFR classification of hedge funds because it enables to examine one special group of hedge funds, i.e. event-driven hedge funds. These funds represent probably the most challenging and promising hedge funds due to their specific character that enables the performance enhancement when and if specified event occurs. The aim of paper is to analyze and evaluate performance of event-driven hedge funds against the performance of hedge fund industry performance and traditional investing.

***Keywords**: hedge funds, strategy, event-driven, performance, Sharpe ratio*

1. INTRODUCTION

Although hedge funds originated from the end of 1940s, there is no precise definition of hedge funds until today, instead numerous definitions exists. Originally, hedge funds were private partnerships that took long and short equity positions to reduce net market exposure by accepting a lower return on investments. However, today the term hedge fund has a much broader meaning because of different portfolio characteristics. Hedge funds represent a type of alternative investment and their activities have a substantial share in trading volume in many traditional markets. Structures of hedge funds commonly enable them to be widely regulated although the pressure toward adequate regulations has grown since the financial crisis in 2007. Hedge funds are usually private pools that can avoid reporting and other requirements as well as restrictions in fees. However, the majority of hedge funds have a certain number of common characteristics, such as: unusual legal structure (e.g. limited partnerships or limited liability companies in the U.S.A.), active management (that affect their performance), flexible investment policy (that enables the fund managers to take positions according to their perceived return or risk expectations), limited transparency, limited liquidity (funds are focused to daily liquidity), orientation to specific investors (e.g. high net worth individuals) and, strategies are not adjustable (but depend on manager"s skill and the investments availability). This could cause problems with transparency and liquidity, low rate of attrition (measured by number of survived funds over specified period of time) (Gregoriou (2002)), exposure to asset risk (because of investing in illiquid asset and use of leverage), tax inefficiency and biases in reported data.

Hedge funds are the fastest growing group within the alternative investment over the last fifteen years. At the end of 2014, the assets under management of the global hedge fund industry was $2.25 trillion and the number of hedge funds exceeded 11,000 (Eurekahedge (2016). This remarkable growth led to substantial differentiation among hedge funds (especially in investment styles used). So, it was impossible to create hedge fund classification. Hence, the special characteristics of a specified hedge fund are mostly result of investment strategy that is implemented. Consequently, the hedge funds can be classified based on investment strategy. In this regard many different hedge fund classifications created by a number of companies exist (e.g. Morningstar, Hedge Fund Research (HFR), Morgan Stanley Capital International (MSCI), Center for International Securities and Derivatives Markets (CISDM), Credit Suisse/Tremont etc.). Regardless the hedge fund classification used, each hedge fund manager will pursue his/her own strategy, which will be developed and changed over time due to fast development of hedge fund industry. In fact, the hedge fund classification by using investment strategy criterion is a result of hedge funds" fast development. The goal of hedge funds classification is to create the funds that will satisfy the investors" needs. Besides this, over time emerged vendors of hedge funds" performance monthly and daily data. These companies collect data of thousands of hedge funds can sell the information to those investors interested in monitoring and/or evaluating hedge funds" performances. The hedge fund managers could be interested in the use of data provided by specific company because in this way they can show their performance within the industry and may attract new investors. Of course, hedge funds are free to provide or not to provide reports to vendors, and this may result in lack of information in situations when they are preparing for new investment or when they returns are deteriorating. Namely, hedge fund data (or the lack of data) are of the key

significance for hedge fund indices creation as well as their reliability. The creation of hedge fund indices enabled the measurement of performance of hedge funds.
Because the aim of paper is to analyze and evaluate performance of event-driven hedge funds against the performance of hedge fund industry performance and traditional investing, we decide to use Hedge Fund Research (HFR) hedge fund classification with a focus to event-driven strategies only. According to HFR hedge funds or hedge fund strategies are classified as (HFR (2016)): equity hedge, event-driven, macro, relative value and fund of funds. Equity hedge funds are oriented in investing in equities by using market neutral strategy, fundamental growth or value strategies, quantitative directional strategy, sector investing strategy, short bias strategy and multi strategy. Event-driven hedge funds are engaged in investing in companies that became attractive for investment because of specific event(s) has happened. The event-driven strategies are: activist, credit arbitrage, distresses/restructuring, merger arbitrage, private issue (regulation D), special situations and multi strategy. Hedge funds that use macro investing may apply: active trading, commodity investing, currency investing, discretionary thematic investing, systematic diversified investing and multi strategy. Relative value hedge funds implement: fixed income– asset backed investing, fixed income–convertible arbitrage, fixed income–corporate investing, fixed income–sovereign investing, volatility investing and multi strategy. In addition, the performance of event-driven strategies is examined by using HFR indices, i.e. Global Hedge Fund Index, HFR Event-driven Index and HFR Event-driven subindices (HFRX Indices (August 2015)).

2. CHARACTERISTICS OF EVENT-DRIVEN HEDGE FUND STRATEGIES

Event-driven hedge fund strategies are loosely defined. Regardless this, event-driven hedge funds try to achieve return on investments in companies that might experience occurrence of specific events over their lives. Such events may include recapitalizations, reorganizations, restructuring, mergers and acquisitions, initial public offerings, buybacks of shares and bankruptcies. The probability of these events occurrence creates an opportunity for hedge funds to make correct anticipation. Hedge funds usually use different types of securities (common shares, preferred shares, bonds etc.) which prices are considered mispriced. These strategies could be considers non-directional ones because they greatly dependent on company-specific situations that are low correlated or not correlated to market movements. Hedge funds managers commonly allocate their assets on distressed securities, merger and acquisitions and other special situations. Advantages of event-driven strategies are: possibility of achieving returns with limit market risk; returns are based on specific events of the company; less correlation with equity markets because of possibility to invest in different securities. Although the event-driven strategies attractiveness to investors, they can have certain disadvantages, such as investing in relatively illiquid securities which may affect the returns, as well as their broadly and imprecisely definition that requires the time for identifying the potential investment opportunity.
When the event has been announced (e.g. in press), hedge funds managers would analyze what is happening and would try to anticipate the outcome of an announced event (and not the event occurrence). Managers will perform fundamental analysis by combining strategic, operational, financial and legal effects in order to estimate what will happen and to take appropriate position. In this regard, managers may decide to invest in events with favourable outcome expectations, but they can also take positions in events with unfavourable outcome by betting on non-occurrence of the events. Besides this, managers have to determine an investment horizon and to select the securities that can be used to profit from event occurrence/non-occurrence. The securities analysis will be related (is related) to securities" prices analysis and risk analysis. Finally, managers will have to specify the securities in which the positions will be taken (partial or full) as well as the ways in which the taken positions could be closed. Before investment decision is made, event-driven hedge fund managers will determine the spread between the market value of a security and their own estimation of the value of the security. They will search the event that could change the attractiveness of the company because of its market value change. Managers will assess the time necessary for both event visibility and company"s market value change. The key risks of event-driven strategy implementation are related to the uncertainty of events outcomes, i.e. inability of foresight the occurrence of the events, outcome, time necessary to achieve the goal and, the change in securities" prices. Because of that the managers will try to diversify their portfolios and to combine positions in equities, bonds and derivatives (to hedge equity or bond portfolios).
The analysis of event-driven hedge funds strategies is based on Hedge Fund Research, Inc. classification (HFR (2016)) that divides all event-driven strategies into following substrategies: activist, credit arbitrage, distresses/restructuring, merger arbitrage, private issue (regulation D), special situations and multi strategy. Their markets are cyclical, which means that each substrategy will achieve the best performance at certain periods over cycles. While the hedge funds involved in special situations could be active at any phase of the cycle, the hedge funds oriented to active investing and/or mergers and acquisition would be the most active during the during expansion. Finally, the distressed companies as well as non-distressed ones may become attractive after the recession. Apart from cyclical nature of event-driven substrategies, most hedge funds" managers are specialized in particular substrategy according to their risk-return profiles.

2.1. Characteristics of activist hedge funds

The number of activist hedge funds is increasing because of the successful development of hedge fund industry. Activist hedge funds do not exist in many countries, and the largest funds are those that operate in the U.S.A. and the United Kingdom (Brav et al. (2008)). The goal of activist hedge funds is to invest in companies that may have better performances if a specific event happens. Activist hedge funds may be friendly (work with the company"s management in order to make necessary changes) or unfriendly (work with the company"s large shareholders in order to make necessary changes). Regardless this, these hedge funds will analyze the companies so that can identify the most promising ones if some changes were to be performed (e.g. strategic reorientation, change in management, sale of business units etc.). The financial strength of particular hedge fund will influence on whether to invest in medium-sized or small companies.
In order to accomplish the goal, activist huge fund manager would have to identify the market(s) in which the funds are to be invested by focusing on specific sectors and specific companies within the chosen sector and to value them (absolutely and relatively). Usually, the hedge funds would invest in undervalued companies, companies that have been profitable over the enough long period of time but in which the cost need to be reduced or cash management has to be improved. Besides this, hedge funds would be interested to invest in low profitable companies (to make them more profitable), smaller fast growing companies that need financing or expertise knowledge and in undervalued companies that are leaders in particular sectors (because their real values are difficult to estimate). Usually, the hedge funds would invest in underpriced companies, companies that have been profitable over the enough long past period of time but in which the costs need to be reduced or cash management has to be improved, low profitable companies (to make them more profitable), smaller, fast growing companies that need financing or expertise knowledge and, undervalued companies that have leading positions in sectors (because of problems in estimate their real values). Thus, by improving the company"s inefficiency and by eliminating the market price discount, hedge funds receive a premium (Boyson, and Mooradian (2011).
After the sectors and companies are identified, the managers would have to analyze the companies" management and to find the tools to create the value of the company which may require time (up to two or three years). That"s why managers would take limited number of active positions and would have a certain number of so-called sleeping positions in their portfolios. Moreover, the value of a company could be changed because of many global factors influence, which may lead to hedge fund"s risk exposure. Hence, the hedging is not advisable because this can even increase the overall risk of the portfolio (e.g. company"s management opposite view to what has to be changed). So, the key source of risk is the portfolio concentration (large positions relative to the company"s size). Besides this, the funds might be exposed to risk of investing in low profitable companies, risk of strategy implementation etc. In reality, hedge funds could earn desirable return from investing in just one company. Hence, the most important factor of this strategy success is to have specialized and experienced fund manager capable to improve the value of the chosen company.

2.2. Characteristics of credit arbitrage

Credit arbitrage strategies try to identify the return potentials in corporate debt securities, such as bank loans, senior and subordinated bonds issued by the company and structured position with quite low credit risk exposure. Hedge funds „managers commonly use fundamental credit analysis to evaluate the probability of issuer"s credit rating improvement. The market of corporate debt securities is liquid, which enables the manager to use general hedging techniques in order to reduce the credit risk exposure.
Credit arbitrage hedge funds seek to have minimal monthly volatility along with acceptable return. Managers of these funds will commonly take both long and short positions in different corporate debt securities. In other words, managers want to take advantage of any perceived mispricing in capital structure related to the corporate debt securities issuance.

2.3. Characteristics of distress/restructuring investments of hedge funds (hedge funds)

Distressed securities are securities of companies which are in financial distress (involved or to be involved in restructuring, reorganization, bankruptcy or liquidation) which means that companies cannot fulfil their credit obligations (cannot make interest payments or cannot repay the loans or face value of bonds). Company may fall into distress for a number of reasons, such as overleveraged, liquidity problems, credit rating downgrade, poor operating performance etc. Distressed securities are commonly have low credit rating (CCC and below). Because of distressed market inefficiency, distressed securities are selling with significant discounts. Types of distressed securities are: trade claims and receivables, common shares, preferred shares, private investment in private equities, rights and warrants, high yield bonds, corporate bonds, municipal bonds, below par bank loans, debtor in possession loans, mezzanine loans, bridge loans, collateralized debt, second lien notes, real estate assets, futures, options, swaps and indices. Investors in

distressed companies" securities are specific compared to investors in non-distressed securities because some investors are not allowed to own securities below a certain credit rating or to own post-reorganization securities or just because they cannot provide fresh capital to the company. In this respect, the investors in distressed securities are: hedge funds, money managers, mutual funds and private equity firms. However, hedge funds represent the largest buyers of distressed securities.
Distressed securities hedge funds „managers combine the fundamental analysis of a company of interest with knowledge of restructuring and bankruptcy in order to identify whether to investment in distressed company or not. In other words, managers would try to forecast and, if necessary, to influence the outcome of the bankruptcies and reorganizations. In general, hedge funds can profit from investing in distressed company by estimating the intrinsic value of the company. Namely, if the market value of a security is significantly below the estimated intrinsic value and managers expect that the security"s market value will increase and reach the intrinsic value hedge funds will take position in distressed securities or will increase the already taken position. On the other hand, hedge funds can have combined positions in securities that are considered relatively mispriced (buying cheap securities and taking short position in more expensive securities). Hence, distressed securities hedge funds" managers will commonly invest long and short in the distressed securities of companies undergoing financial rather than operational distress (i.e. good companies with bad figures in their balance sheets). According to their expertise knowledge, hedge funds" managers will be concentrated on certain sectors and will implement active or passive investment approaches. Active investment approach means that managers will attempt to influence the restructuring through active participation in a creditor committee, while the passive investment approach is oriented to buying and holding distressed securities until they appreciate.

Distressed securities hedge funds can provide relatively high returns regardless the current market conditions because the returns are the result of managers" skills. The main disadvantage of distressed securities investments is illiquidity (i.e. it"s hard and sometimes impossible to liquidate the positions taken by the hedge funds). Hedge funds" managers" decision to invest when the financial distressed emerged or to wait and invest later is based on expectations of company"s recovery. The greater the likelihood that the company will be recovered, the hedge fund will invest earlier.
Distressed securities hedge funds are exposed to risk. Because of this, managers of hedge funds have to manage the portfolio risk by diversifying across various industries, companies and securities. Managers can use different hedging instruments.

2.4. Characteristics of merger arbitrage

Merger arbitrage hedge funds are funds that are investing in companies undergoing mergers and acquisition in order to achieve arbitrage returns. In other words, managers take a long position in equity of a target company and simultaneously take short position in equity of an acquirer. Managers of these hedge funds strive to profit from the uncertainty of the announced event (e.g. bid announcement). Merger arbitrage (or risk arbitrage) can be realized by friendly takeover (return is a difference in the buy and sale share prices) or hostile takeovers (hostile public offerings of shares that requires the probability that target company"s shareholders will be forced to sell their shares) or partial sale (of a company which price is either below market value or intrinsic value).
The main advantage of this strategy is that it offers achievement of attractive returns with a relatively limited market risk exposure (returns dominantly depend on company events). The strategy has a much shorter investment horizon compared to other event-driven strategies. Finally, the investing decisions are based on available information only. On the other hand, merger arbitrage strategy disadvantages are inability to offer the same return over investment period and relatively high volatility.
Before the investment decision is made, manager of hedge fund has to identify the company of interest and to analyze it so that can estimate the probability of event success as well as the market reaction to the specific event. Based on this, hedge fund manager will try to determine whether to take position in the company or not. If manager is about to take position in company, the availability of information will affect the size of the position that should be taken. In addition, the market price at which the company"s shares could be sold and the uncertainty of transaction effect on buyer"s price have to be taken into accounts. The aim is to hedge positions.
The main risk of merger arbitrage is related to merger and acquisition process incompletion. Should the acquisition deal not be completed, the target"s stock price will fall and merger arbitrage hedge fund could incur significant loss. Nevertheless the level of risk undertaken varies among the merger arbitrage hedge funds. Some hedge funds" managers will invest in announced mergers and acquisition only, while others will invest before the merger or acquisition is officially announced.

2.5. Characteristics of private issue/regulation D

Private Issue/Regulation D strategies which employ an investment process primarily focused on opportunities in equity and equity related instruments of companies which are primarily private and illiquid in nature. These most frequently involve realizing an investment premium for holding private obligations or securities for which a reasonably liquid market does not readily exist until such time as a catalyst such as new security issuance or emergence from bankruptcy proceedings occurs. Managers employ fundamental valuation processes focused on asset coverage of securities of issuer firms, and would expect over a given market cycle to maintain greater than 50% of the portfolio in private securities, including Regulation D or PIPE transactions.

2.6. Characteristics of special situations

Special situations represent a strategy that is related to all events other than mergers and acquisitions or bankruptcies. In other words, this strategy is referred to situations, such as companies with depressed values of their shares, unannounced mergers and acquisitions, recapitalization, refinancing, reorganization, public offering, leveraged buy-out, government privatization etc. The position taken in these situations can be combined with the positions that are already taken in distressed securities or in mergers. This substrategy is focused on opportunities in equity and equity-linked securities of companies that are involved in different corporate situations. In other words, strategy include both announced and non-announcement events. The managers are oriented to corporate investing in a numerous forms (e.g. distressed securities, issuance of bankruptcy securities, asset sales etc.) that are identified by fundamental analysis. Strategies do not employ leverage, but returns on investments made exhibit greater volatility than other event-driven hedge funds.

2.7. Characteristics of multi strategy

Multi strategy represents a hedge fund strategy that combines two to five investment strategies in order to offer a diversified product. That means that the company may offer individual funds, multi strategy fund or a diversified portfolio only. Each strategy is typically managed independently. In order to limit exposure to manger and to reduce the risk of strategy implementation, the capital is allocated among various managers.
The strategy collapse may be stable over time or can be actively managed. When the strategy is managed in-house, the breakdown between strategies will tend to be stable or to evolve within bands. When external teams are used, the lead manager of the global portfolio usually retains the right to change the capital allocation over time. In this case rebalancing will usually be carried out monthly, quarterly or semi-annually (Capocci (2007) and Capocci and Hubner (2004)).
Multi strategy is characterized by a number of advantages. Multi strategy offers a diversified exposure to hedge funds. The provided liquidity is usually similar to liquidity of underlying strategies or can be even better. The strategy enables the hedge funds to diversify the risk of individual strategy. Multi strategy does not require a due diligence on underlying manager which influence the cost reduction. Finally, this strategy enables monthly (or quarterly) or consistently rebalancing. On the other hand, the multi strategy has its limitations. The main drawback of multi strategy hedge funds is the lack of freedom in making decision regarding the underlying manager. Hedge funds tend to stick to the same manager even if performance is poor. In addition, multi strategy hedge funds" managers can have a different level of transparency and invisibility to potential investors.

3. PERFORMANCE OF EVENT-DRIVEN STRATEGIES OF HEDGE FUNDS

Hedge funds performance evaluation is enabled by creation of hedge funds indices. Although these indices are still suffering from lack of continuous and complete data, they are capable of indicating the recent hedge funds" performances with a small error and can help investors determine expectations of their own hedge funds. Even though no universal hedge fund index can adequately represent the hedge fund industry as a whole and although existing indices differ in composition and performance, hedge fund indices are enough good indicators of hedge funds" performances. There are different providers of hedge fund indices, but despite this the indices are usually divided according to investment strategy of a hedge fund. Most firms publishing indices have an index for each hedge fund strategy and commonly subindices within the particular strategy. So, the investors can track with reasonable confidence the performance of hedge funds that pursues a specified investment strategy. In addition, the today"s development of hedge funds indices is supported by the inception of investable indices, i.e. the indices that mimic the aggregate performance of individual hedge fund strategies (e.g. Morgan Stanley Capital International Inc. and Standard&Poor"s). Having this in mind, the investors should carefully choose a hedge fund index because of its representativeness of industry performance as well as the imperfect hedge fund databases.

Performance of hedge funds strategies is usually evaluated based on detailed analysis of daily, monthly or quarterly returns and their standard deviations, correlations among different hedge funds strategies and among hedge funds indices and equity and/or bond indices. The frequently used performance measure is Sharpe ratio. Sharpe ratio was introduced by William Sharpe (Sharpe (1966)) as a measure of mutual funds performance. Sharpe proposed a term reward-to-variability ratio (Sharpe (1975)) that indicates the expected differential return per unit of risk associated with the differential return (ex ante ratio) or the historic average differential return per unit of historic variability of the differential return (ex post ratio). Specifically, measures the return adjusted for each level of risk undertaken. It represents a ratio between the difference in average return on investment and risk-free rate and standard deviation of the returns. This ratio can be applied to different hedge funds regarding return and volatility relationship. The higher the value of Sharpe ratio, the higher return investors can expect to receive for additional risk accepted by investing in riskier assets. Several authors pointed out to drawbacks of Sharpe ratio and other traditional performance measures. Among them, the most attention deserve Cappoci, Duquenne and Hubner (2007) who developed an extended risk measure that integrates the specific features of alternative strategies. Besides, some authors proposed and examined the use of Sortino ratio (van Dyk, van Vuuren and Heymans (2014) and Omega ratio (Botha (2007). Despite a number of shortages, the most consistent and widely used measure of hedge funds" performances is Sharpe ratio and this is the performance analysis of event-driven hedge funds is based on this ratio.

Capocci (2009) and Cappoci and Hubner (2004), Agarwal (2001), Agarwal and Naik (2000), Bertelli (2007), Fung and Hseih (2002b) and Gregoriou et al. (2006) had analyzed the general or partial performance of hedge funds. Nevertheless, there are is analysis focused on event-driven strategy. That"s why the paper tries to analyze this specific and important group of strategies. Availability and consistency in data represent a relatively great weakness, but we tried to overcome this problem by the use of publicly available date of event-driven hedge funds" index and subindices of HFR (HFRX Indices (August 2015)).

According to HFR hedge fund strategies classification, the event-driven strategy has substrategies, and their performance is could be traced by values of strategy"s index and subindices (event-driven index, activist index, credit arbitrage index, distressed/restructuring index, merger arbitrage index, special situations index and multi strategy index). Performance of private issue/regulation D could not be analyzed because for this hedge fund strategy no subindex exists.

The performance of event-driven strategies is analyzed on the basis of data provided by Hedge Fund Research of HFRX Global Hedge Fund Index (HFRXGL), HFRX Event-driven index (HFRXED), MSCI US$ World Index (MSCI (2016) and S&P 500 w/dividends over the 1998-2014. In order to analyze the performance of event-driven hedge funds, we firstly compare the data that may indicate the performance of the event-driven hedge fund index with the performance of Global hedge fund index (the observed period was the same). The HFRX Global Hedge Fund Index (HFRXGL) is designed to be representative of the overall composition of the hedge fund universe. Over the period of concern (1998-2014) HFRXGL had geometric average monthly return of 0.39%, which was higher than the returns both on 3-month LIBOR and MSCI World Index (0.21% and 0.27% respectively). Standard deviation of monthly returns was 1.8, i.e. the volatility was greater than for 3-month LIBOR (0.19) but significantly lower than for MSCI World Index (4.56). Annualized return of HFRXGL was 4.82% and was higher than both 3-month LIBOR and MSCI World Index (2.59% and 3.24% respectively). The annualized standard deviation of returns was 6.24 and that was higher than 3-month LIBOR (0.65) and significantly lower than for MSCI World Index (15.80). The risk-free rate over the analyzed period was 2.11%. Correlation between HFRXGL and 3-month USD LIBOR was low positive (0.17), while was significantly positive between HFRXGL and MSCI World Index (0.63). Finally, Sharpe ratio as a measure of global hedge fund performance was 0.45 or better than ratio for MSCI World Index (0.15) but weaker than for 3-month LIBOR (0.69). The HFRX Event-driven Index (HFRXED) is designed to be representative for all hedge funds pursuing event-driven strategies. Over the period of concern (1998-2014) HFRXED had geometric average monthly return of 0.37%, substantially higher than the returns on MSCI index (0.27%) and slightly lower the returns on both S&P 500 w/dividends and HFRXGL (0.49% and 0.39% respectively). Standard deviation of HFRXED returns was 1.93, which was slightly greater than the standard deviation of HFRXGL (1.8) and substantially lower than the standard deviations of both MSCI and S&P 500 indices (4.55 and 4.46 respectively). Annualized return on HFRXED was 4.52% which were lower than the return on S&P 500 (6.04%) and higher than the returns on both MSCI index and HFRXGL (3.24% and 4.82% respectively). Annualized standard deviation of HFRXED returns was 6.68 and it was slightly greater than for HFRXGL (6.24) but substantially lower than the standard deviations of both MSCI and S&P 500 indices (15.80 and 15.45 respectively). This can be partly explained by financial crisis influence on hedge fund industry and especially on hedge funds that followed some event-driven substrategies. Correlation between the HFRXED and MSCI World index was 0.70 which was greater than the correlation coefficient for HRFXGL (0.63). Finally, Sharpe ratio as a performance measure was 0.38 for HFRXED, which was higher than ratios values for both MSCI and S&P 500 indices (0.15 and 0.32 respectively), but lower than ratio of HFRXGL (0.45). This may suggest that because of specific characteristics of event-driven strategies, the hedge fund industry performed slightly better. In general, it seemed that hedge funds as a whole performed better than

event-driven hedge funds. Hence, it would be difficult to give the final conclusion regarding event-driven hedge funds" performance. In other words, more detailed analysis should be done.

Event-driven hedge funds attempt to enable investors to diversify their investments. In general, the rational for diversification would depend on correlation between the assets within the investment portfolio. The correlation is measured by correlation coefficient that may take values from -1 to + 1. Ideally, the best diversification and risk reduction would be obtained if coefficient had value of -1 (negative correlation). On the other hand, diversification wouldn't reduce the risk exposure if coefficient is +1. In general, as long as acceptable positive correlation exists between assets, it would've been worth of adding asset in the given portfolio. Having this in mind, the table 1 is created with a goal to give the information regarding the historical correlations between event-driven hedge funds and classical indices.

Results presented in table 1 are in accordance to what could've been expected from event-driven substrategies. All event-driven substrategies are positively correlated to both MSCI World index and S&P 500 w/dividends, except for activist hedge funds, which can be explained by the specific active role they commonly undertake in companies of interest. Apart from this, we tried to determine the correlation between event-driven strategies over the whole period, but the inconsistency in data and the lack of data for some years, not allowed us to do so. However, we managed to determine the correlation between only two event-driven substrategies (distressed/restructuring and merger arbitrage). In this regard, correlation coefficients were 0.57 which could be considered attractive to further portfolio diversification. With further development of event-driven hedge fund data collection and creation of wider range of subindices, the correlation would be possible to examine and to make useful conclusion about how to combine event-driven substrategies in order to enhance the hedge funds" return.

Table 1: Correlation between event-driven substrategies and market indices (1998-2014)

	Correlation with MSCI World index	S&P 500 w/div
Activist index	– 0.60	0.65
Credit arbitrage index	0.67	0.62
Distressed restructuring index	0.49	0.61
Merger arbitrage index	0.44	0.41
Special situations index	0.75	0.69
Multi strategy index	0.66	0.59

Source: HFRX Indices, Hedge Fund Research Inc., August 2015; MSCI World Index-annual performance- 1998-2014, MSCI Inc., 2016.

Table 2: Performance of event driven strategy and event-driven substrategies 1998-2014

	Event-driven index	Activist index	Credit arbitrage index	Distressed /restructu-ring index	Merger arbitrage index	Special situations index	Multi strategy index
GAMR* (%)							
Subindex	0.37	0.57	0.60	0.24	0.44	0.15	0.52
MSCI index	0.27	0.27	0.27	0.27	0.25	0.27	0.27
&P500w/div.	0.49	0.56	0.56	0.07	0.49	0.56	0.56
SDMR*							
Subindex	1.93	3.98	1.12	2.02	0.99	2.21	2.61
MSCI index	4.56	4.55	4.55	4.56	4.21	4.55	4.55
S&P500w/div	4.46	4.19	4.19	2.19	4.46	4.19	4.19
Annualized return (%)							
Subindex	4.52	7.00	7.50	2.91	5.36	1.81	6.41
MSCI index	3.24	3.25	3.25	3.24	2.99	3.25	3.25
&P500w/div.	6.04	6.88	6.88	0.82	6.04	6.88	6.88
SDAR*							
Subindex	6.68	13.80	3.89	7.00	3.43	7.64	9.03
MSCI index	15.80	15.78	15.78	15.80	14.60	15.78	15.78
&P500w/div.	15.45	14.51	14.51	7.60	15.45	14.51	14.51
Sharpe ratio							
Subindex	0.38	0.46	1.54	0.14	0.93	0.10	0.59
MSCI index	0.15	0.20	0.20	0.15	0.13	0.20	0.20
S&P500w/div.	0.32	0.44	0.44	(0.13)	0.32	0.44	0.44

Data source: HFRX Indices, Hedge Fund Research Inc., August 2015; MSCI World Index-annual performance: 1998-2015, MSCI Inc., 2016.

*GAMR - Geometric average monthly return; SDMR - Standard deviation of monthly returns; Standard deviation of annualized returns.

Finally, on the basis of date used, the performance of event-driven substrategies was analyzed by comparison of returns (monthly and annually), standard deviations (monthly and annually) and Sharpe ratio. The aim was to research in more details the performance of event-driven hedge fund substrategies because this issue have been insufficiently explored. Table 2 shows the results that indicate the performance and potential of particular event-driven substrategies. In summary, table 2 suggests that best performing strategies are credit arbitrage and merger arbitrage which is in line with the market conditions deterioration after the financial crisis emergence in 2007 and strategies" orientations. Activist and multi strategy were "medium-performed" ones, while the weakest performing were distressed/restructuring and special situations strategies. The results should be analyzed in broader context, especially because of the fact that distressed/restructuring and special situations strategies are commonly low correlated to traditional investments (e.g. shares and bonds) and frequently related to low liquid assets.

4. CONCLUSION

Hedge funds are the fastest growing group within the alternative investment over the last fifteen years because of unique characteristics and the return potential with medium or low volatility and commonly medium or low risk exposure. The hedge funds are usually defined by the investment strategy they implement. Hedge funds loosely regulation and commonly lack of transparency led to wide range of hedge funds" strategies which are formulated to suite the investors need. Over time investors required more and more information about their investments returns and performance. As a result specialized companies emerged and started to provide data of hedge funds" operations and shortly after this, created hedge fund indices. This encouraged more investors to invest in hedge funds. There is variety of different hedge funds" investment strategies. Having in mind, the consistency and use of different hedge funds" classification, the paper was based on HFR classification of hedge funds because it enables to examine one special group of hedge funds, i.e. event-driven hedge funds. These funds represent probably the most challenging and promising hedge funds due to their specific character that enables the performance enhancement when and if specified event occurs. The performance of event-driven hedge funds can be measured, not only in terms of returns (daily and month) and standard deviation of returns, but also by using Sharpe ratio as widely used measure of hedge funds" performance. The analysis of event-driven hedge funds" performance showed relatively good performance though slightly weaker than the performance of hedge funds industry as a whole. Compared to widely used market indices (such as MSCI World Index and S&P 500), performance of event-driven strategies was better. Best performing strategies were credit arbitrage and merger arbitrage which is in line with the market conditions deterioration after the financial crisis in 2007 and strategies" orientations. Activist and multi strategy were "medium-performed" ones, while the weakest performing were distressed/restructuring and special situations strategies.

REFERENCES

Agarwal, V., & Naik, N. (2000) Multi-period performance persistence analysis of hedge funds. *Journal of Financial and Quantitative Analysis*, 35, 327–42.

Agarwal, V. (2001). Intertemporal variation in the performance of hedge funds employing a contingent-claim-based benchmark. *Working paper*, London Business School.

Bertelli, R. (2007). Financial leverage: risks and performance in hedge fund strategies. Working paper, Department of Economic Law, *University of Siena*, Italy, 13.

Botha, M. (2007). A Comparison of South African hedge fund risk measures. *South African Journal of Economics*. 75(3), 459-477.

Boyson, N. M., & Mooradian, R. M. (2011). Corporate governance and hedge fund activism. *Review of Derivatives Research*. 14(2) , 169-204.

Brav, A. P., Jiang, W., Thomas, R. S., and Partnoy, F. (2008). Hedge fund activism, corporate governance, and firm performance. *Journal of Finance*. 63, 1729, 2008. -activist

Capocci, D. (2009). Hedge fund daily returns: a preliminary analysis in "Finance and Valeur(s): Liber Amicorum and Discipulorum, *Les Editions de l'Universite de Liege*, 255.

Capocci, D., Duquenne, F., and Hubner, G. (2007). Diversifying using hedge funds: a utility-based approach. *Working paper*. University of Liege.

Capocci, D. (2007). An analysis of hedge fund strategies. *Ph.D. Thesis*. Universite de Liege, Retrived from n www.ssrn.com.

Capocci, D.,& Hubner G. (2004). An analysis of hedge fund performance. *Journal of Empirical Finance*. 11(1), 55–89.

Eurekahedge. (January 2016). Eurekahedge report.

Fung, W., & Hsieh, D. (1997). Empirical characteristics of dynamic trading strategies: the case of hedge funds. *Review of Financial Studies*. 10, 275–302.

Fung, W., & Hsieh, D. (2002b) Benchmarks of hedge fund performance: information content and measurement biases. *Financial Analyst Journal*. 58, 22–34.
Gregoriou, G.N., Hubner, G., Papageorgiou, N and Rouah, F. (2006) Dominating funds of funds with simple hedge fund strategies in "Fund of Hedge Funds: Performance, Assessment, Diversification and Statistical Properties", Elsevier.
Gregoriou G.N. (2002). Hedge fund survival lifetimes. *Journal of Asset Management*. 3 (3), 237–252.
Liang, B. (2001). Hedge funds performance: 1990–1999. *Financial Analysts Journal*. January/February, 11–18.
HFRX Indices (August 2015). Hedge Fund Research Inc..
HFR Hedge Fund Strategy Classification System. (2016). Hedge Fund Research, Inc.
MSCI World Index-annual performance: 1998-2015. (2016). MSCI Inc.
Sharpe, W. F. (1992). Asset allocation: management style and performance measurement. *Journal of Portfolio Management*. 18(2), 7–19.
Sharpe, W. F. (1966). Mutual fund performance. *Journal of Business*. January, 119–138.
Van Dyk F., Van Vuuren G., and Heymans A. (2014). Hedge fund performance evaluation using the Sharpe and Omega ratios. *International Business & Economics Research Journal*. 13(3), 485-512.

USING FINANCIAL STATEMENT DATA TO EXPLAIN STOCK PRICE MOVEMENTS - BELGRADE STOCK EXCHANGE CASE

Teodora Mešić*[1], Jovan Milovanović[1], Aleksandar Rakićević[1]
[1]University of Belgrade, Faculty of organizational sciences,
*Corresponding author, e-mail: mesicteodora1@gmail.com

Abstract: *This study uses regression as a tool to create regression models that are able to explain stock price movements based on selected financial statement data and financial ratios. For the purpose of this study, we build both univariate and multivariate linear regression models. The proposed models are used to explain stock price movements for Prime Listing companies in Belgrade Stock Exchange. To explain stock price movements, we use in total nine financial statement items and five ratios as independent variables in our regression models. The results shows that the best method to explain and predict future price movements is to analyze raw financial statement data. Good results are also achieved using DuPont decomposition ratios.*

Keywords*: stock price, regression, financial ratios, financial statements, forecasting*

1. INTRODUCTION

In the analysis of rational investment behavior it is necessary to observe two key things: possible profit and risks. Often the investment motives are tested by investing in equities that are the most extensively traded and most valuable in stock markets. Stock prices are the basic and most important indicator to observe successfulness of the company. More precisely, positive movements in share prices indicates success and higher valuation. Therefore, using stock prices we can learn a lot about companies' operating quality, efficiency and effectiveness of governance for the future of the company. It is important to understand stock price movements and their dependence on various factors.

Research aim or research questions need to be fairly well defined. This is an important point. We always need to have a clear focus on what we want to find out. Without a clear research question, it becomes much harder to understand both which data sources to look for and which techniques to employ. In applied research, we use a range of statistical techniques. We tend to distinguish between univariate(summaries and inferences about a *single* [uni-] variable), bivariate (summaries and inferences about the relationships between *two* [bi-] variables) and multivariate (summaries and inferences about the relationships between *three* or more [multiple] variables) statistics.

In this study, we focused on bivariate and multivariate statistics. The idea was to use statistics as a model of real world problems. In other words, we used mathematical models in order to understand and explain events regarding the study theme. We used regression to explain influence of the data from financial reports and ratios calculated based on this data on stock price movements, namely correlation between these two. Linear regression is used for experiments where only one factor that influences stock price is observed, in our case the influence of one valuation ratio on stock price. On the other side, we used multiple regression when more factors have to be taken into account (influence of several ratios on stock price). We divided input data in two sections: financial statement data (net profit, interest expenses, short term liabilities, etc) and ratio data derived from financial statement data (return on assets, return on equity, profit margin, asset turnover, financial leverage).

The rest of the paper is organized as follows. In the next section we give a brief background about this subject, and mention some of the most important work. Detailed explanation of methodology and our model is provided in Section 3. Section 4 gives brief explanation of data sample and presents results of our experiment with the corresponding discussion. Section 5 concludes our paper and give some thoughts for further work.

2. BACKGROUND

Analyzing correlation between current earnings, income and financial statement data in general, and stock prices is very important topic in finance. Understanding this relationship is crucial, especially for those who are participating stock markets. Beaver (1998) says that one link, theoretically speaking, between earnings and stock prices is that current earnings and other data from financial reports provide information to predict

future stock prices and thus future earnings. Based on this statement, researches have looked for current financial report information to predict future movements in stock price and earnings, pointing out that this should be one of the main goal of fundamental analysis (Penman, 1992; Lee, 1999).

Sloan (1996) decomposed earnings into accruals and cash flows and found that companies with higher operating accrual tend to have lower future earnings and returns. Lewellen (2004) studied whether financial ratios like dividend yield can predict aggregate stock returns. He showed that dividend yield can predict market returns in a whole sample, while book-to-market and price-per-earnings ratios have predictive power in the shorter sample. Soliman (2004) investigated in his study whether the industry-adjusted DuPont analysis is a useful tool in predicting future changes in return-on-net-operating-assets and obtained positive results.

3. METHODOLOGY

In this study, the problem we are focusing on is whether is there a direct dependency between changes in financial statements data (and therefore also changes in financial ratios) and stock price movements. In order to find out the answer on this question we will employ different regression models. The first part of this section will provide a brief overview of regression method. Further, we will present our univariate and multivariate regression models. Finally, at the end of this section, valuation method is provided.

3.1. Regression

Regression is a dependency model. Its' idea is to explain the variation in a certain variable (income, profit, expenditure etc), as a function of explanatory variable(s). In other words, regression tries to figure out to what extent does the variation in explanatory variables explain the variation in the dependent variable?

The basic linear regression model can be set up in the following way:

$$Y = \beta_0 + \beta_1 X + \varepsilon , \tag{1}$$

where β_0 is *Y*-intercept, β_1 is a slope coefficients and ε is a random error term. In this univariate model, changes in *Y* are assumed to be caused by changes in *X*.

If the one independent variable is not enough to explain behavior of dependent variable, we can set a multiple regression model with k independent variables:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k + \varepsilon , \tag{2}$$

where $\beta_0, \beta_1, \ldots, \beta_k$ are regression coefficients and ε is a random error term.

3.2. The proposed model

In our study we perform several experiments. First, we studied stock price movements based on the changes of single variable (return-on-assets, return-on-equity), and second, we studied those movements based on the changes of multiple variables (multiple financial statement data, multiple ratios). Therefore, we used both univariate and multivariate regression models.

Our first model type is the following:

$$P = \beta_0 + \beta_1 R + \varepsilon , \tag{3}$$

where *P* represents stock price, while *R* stands for return-on-equity (ROE) or return-on-assets (ROA) ratio.

Our second model type is the following:

$$P = \beta_0 + \beta_1 PM + \beta_2 AT + \beta_3 FL + \varepsilon , \tag{4}$$

where *PM* represents profit-margin ratio, *AT* stands for asset-turnover and *FL* is financial-leverage ratio. These three ratios represent DuPont decomposition ratios of ROE ratio. We believe that these components of ROE, when put in regression model, have greater explanatory power that the ROE.

Our final model studies influence of financial statement components on stock price movements. Using several items from financial report we build the following regression model:

$$P = \beta_0 + \beta_1 A + \beta_2 C + \beta_3 STL + \beta_4 DTL + \beta_5 LTL + \beta_6 I + \beta_7 EBIT + \beta_8 IE + \beta_9 NP + \varepsilon \,, \tag{5}$$

where *A* represents total assets, *C* is capital, *STL* means short-term liabilities, *DTL* is differed tax liabilities, *LTL* stands for long-term liabilities, *I* is total income, *EBIT* is earnings-before-interest-and-taxes, *IE* are interest expenses, while *NP* is a net profit.

3.3. Method valuation

To determine influencing factors and method success we observed T-statistic, P-Value and R Squared.

R Squared (R^2)

R Squared is a coefficient of determination and represents the portion of the total variation in the dependent variable that is explained by variation in the independent variable.

Table 1: Examples of approximate R^2 value

R^2= 1	R^2 between 0 and 1	R^2= 0
100% of the variation in Y is explained by variation in X	Some but not all of the variation in Y is explained by variation in X	The value of Y does not depend on X (None of the variation in Y is explained by variation in X)

T-test for a population slope

We are trying to understand a linear relationship between X and Y. We have null and alternative hypotheses

$$\begin{aligned} H_0 &: \ \beta_1 = 0 \ \text{(no linear relationship)} \\ H_1 &: \ \beta_1 \neq 0 \ \text{(linear relationship does exist)} \end{aligned}, \tag{6}$$

Test statistic is

$$t = \frac{b_1 - \beta_1}{sb_1} \,, \tag{7}$$

where b_1 is a regression slope coefficient, β_1 is a hypothesized slope, sb_1 is a standard error of the slope. Confidence level is by default 0,95 so $\alpha = 0{,}05$.

In Table 2 we present an example of analysis of influence of ROE on stock price which is the part of our analysis.

Table 2: t-test example

	Coefficients	Standard Error	t Stat
Intercept	98,24833	58,03348	0,12892
ROE	0,10977	0,03297	3,32938

Regression slope coefficient is $b_1 = 0{,}10977$, $sb_1 = 0{,}03297$, while $t = 3{,}32938$.

Further, we look at the T distribution critical value table, and decide whether the *t*-value for ROE falls into the specific interval (which is determined by the critical value table). Since the value for *t* does not fall into critical area, the decision is to reject H_0.

P-Value Method

In this method we starts with the same hypotheses. The following Table 3 presents an example from our analysis.

Table 3: p-value example

	Coefficients	Standard Error	t Stat	P-value
Intercept	98,24833	58,03348	0,12892	0,12892
ROE	0,10977	0,03297	3,32938	0,01039

This is a two-tail test, so the *p*-value is $P(t>3,329)+P(t<-3,329)=0,01039$ (for 8 d.f.). If the *p*-value is smaller than $\alpha=0,05$, we reject H_0. The bigger the *t*-value is, the smaller the *p*-value, and consequently the stronger is the evidence against the H_0 hypotheses. In this example from our study, there is sufficient evidences that ROE affect the stock price.

4. EXPERIMENTAL RESULTS

In the first part of this section we will present data sample used in this study. In the next part we will structure results and provide appropriate comments.

4.1. Data

We used data from the financial reports of Prime Listing companies listed on Belgrade Stock Exchange (BELEX), given the fact that these companies are obliged to inform public quarterly on their results. BELEX Prime Listing is consisted of four companies: Energoprojekt holding (ENHL), Naftna Industrija Srbije (NIIS), Sojaprotein (SJPT) and Aerodrom Nikola Tesla (AERO). Data are taken from the official financial reports of these companies, and can be found on www.belex.rs. Data ranges from the first quarter of 2006 to the last quarter of 2015.

We organized data from the reports, and calculated relevant financial ratios: return-on-equity (ROE), return-on-assets (ROA). In order to analyze relationship between stock price and these ratios more efficiently, we also did DuPont decomposition (Soliman, 2008) of ROA into profit margin (PM) and asset turnover (AT), and ROE into PM, AT and financial leverage (FL).

Table 4: Financial ratio and stock price data

Company	Stock price	ROA	ROE	PM	AT	FL
ENHL	3232	0,039	0,043	0,972	0,040	1,096
	2901	0,034	0,041	0,852	0,040	1,213
	2101	0,034	0,047	0,134	0,254	1,380
	1600	0,079	0,111	0,299	0,265	1,404
	…	…	…	…	…	…
NIIS	506	0,129	0,849	0,151	0,850	6,603
	481	0,177	0,488	0,197	0,902	2,752
	580	0,225	0,692	0,268	0,842	3,071
	624	0,066	0,197	0,074	0,888	2,977
	…	…	…	…	…	…
SJPT	2970	0,047	0,094	0,040	1,179	1,996
	2490	0,079	0,156	0,082	0,960	1,983
	1042	0,092	0,251	0,114	0,806	2,718
	840	-0,009	-0,027	-0,009	1,016	2,985
	…	…	…	…	…	…
AERO	526	0,051	0,056	0,263	0,194	1,092
	484	0,068	0,075	0,300	0,228	1,092
	515	0,088	0,098	0,363	0,243	1,115
	460	0,064	0,070	0,271	0,238	1,092
	…	…	…	…	…	…

4.2. Summary results

Using Excel and its Data analysis tools we tried to determine the dependence between stock price and all factors previously mentioned. Through testing of each individual factor and its impact on the price as well as their combinations, we came to the following results shown in Figure 1.

Company	ROA	ROE	DuPont decomposition ratios*	Financial statement items**
ENHL	✗	✗	✗	✓
NIIS	✗	✗	✓	✓
SJPT	✗	✗	✓	✓
AERO	✓	✓	✓	✓

Figure 1: Summary results

*We use ROE decomposition which include Profit margin, Asset turnover and Financial leverage.
**All items from financial reports are Total assets, Capital, Current liabilities, Deferred tax liabilities, Long-term liabilities, Income, EBIT, Interest expenses, Net profit.

Our summary results shows interesting conclusions. ROA and ROE factors are able to explain stock price movements only in one case – AERO. Further, DuPont decomposition of these ratios into PM, AT and FL gives more explanatory power for stock price prediction. It successfully explained price movements for three stocks: AERO, ENHL and NIIS. It is important to note here, that SJPT experienced several stock splits and also suffered huge losses during the selected time period, which could be a reason why it was difficult to explain its price movements. Finally, using raw financial statement data we obtained the best results in explaining stock market movements. All four stock price movements were explained successfully.

4.2.1. ROE results

The following regression Table 5 presents detailed results for our ROE model.

Table 5: Regression statistics for ROE

Company	R Square	t Stat	P-value
AERO	0,59599	4,02830	0,00199
ENHL	0,01644	0,60640	0,55046
NIIS	0,07712	1,04230	0,31627
SJPT	0,03812	0,95483	0,34962

From the regression table, which examines relationship between ROE and stock price movement, we can see that there is a relative strong influence of ROE on AERO price changes. However, other three companies do not show statistical significance for ROE influence, which means that ROE cannot be used to explain neither predict price movement of these stocks. It is interesting to mention, that analysis of price movements of these stocks showed, that AERO is the only company among these four with relatively steady price trend through time observed.

4.2.2. ROA results

The following regression Table 6 presents detailed results for our ROA model.

Table 6: Regression statistics for ROA

Company	R Square	t Stat	P-value
AERO	0.60199	4.07894	0.00182
ENHL	0.00001	0.01897	0.98503
NIIS	0.00000	0.00334	0.99738
SJPT	0.03021	0.84644	0.40603

ROA, as well as ROE has strong influence on stock price movement in the example of AERO. And again, as in the previous example, this influence is not significant for other three companies.

5. CONCLUSION

In this paper linear regression is used to establish the relationship between data from financial statements and financial ratios, and stock price movements. Experiment was conducted for Prime Listing companies on Belgrade Stock Exchange including Aerodrom Nikola Tesla, Energoprojekt holding, Naftna Industrija Srbije, Sojaprotein.

Our results have shown that the biggest influence on stock price movements have the raw financial statement data. In a way, this was expected result since it is only logical that deep analysis of financial statement items can give us detailed insights in companies performances. The second results were obtained using DuPont decomposition ratios for ROE and ROA profitability measures. Finally, using only ROA and ROE factors seems not to be very helpful for those who wants to understand stock price movements. Our final conclusion is that in financial analysis one should never underestimate a detail inspection of financial statements and other internal factors that influence companies' performances in order to obtain good insight in investment perspective of the stock.

As for the future research, we plan to include more factors in our analysis and to use other statistical and machine learning methods in order to explain stock price movements.

REFERENCES

Abarbanell, J. S., & Bushee, B. J. (1997). Fundamental analysis, future earnings, and stock prices. *Journal of Accounting Research*, *35*(1), 1-24.

Beaver, W. H. (1998). *Financial reporting: an accounting revolution. 3rd edition*. Prentice Hall.

Lee, C. M. (1999). Accounting-based valuation: Impact on business practices and research. *Accounting horizons*, *13*(4), 413-425.

Lewellen, J. (2004). Predicting returns with financial ratios. *Journal of Financial Economics*, *74*(2), 209-235.

Penman, S. H. (1992). Return to fundamentals. *Journal of Accounting, Auditing & Finance*, *7*(4), 465-483.

Soliman, M. T. (2004). Using industry-adjusted DuPont analysis to predict future profitability. *Available at SSRN 456700*.

Soliman, M. T. (2008). The use of DuPont analysis by market participants. *The Accounting Review*, *83*(3), 823-853.

Sloan, R. (1996). Do stock prices fully reflect information in accruals and cash flows about future earnings?(Digest summary). *Accounting review*, *71*(3), 289-315.

APPLYING A NEURO FUZZY SYSTEM FOR CREDIT RISK EVALUATION

Nevena Vranić[1], Javorka Djurić[1], Ivana Dragović[1]
[1]Faculty of Organizational Sciences, University of Belgrade
nevena.vranic@gmail.com

Abstract: *One of the most relevant issues in financial analysis is credit score calculation. In order to solve this problem, numerous methods have been proposed in the literature for credit risk evaluation. In this paper, to create the prediction model for creditworthiness, Neuro-Fuzzy approach has been used, more specifically, an adaptive neuro-fuzzy inference system (ANFIS). In order to reduce the dimensionality problem Principal Component Analysis (PCA) was employed. The system was trained and tested with different number of inputs.*

Keywords*: fuzzy logic, neuro-fuzzy system, ANFIS, Principal Component Analysis, credit risk*

1. INTRODUCTION

In the past years, financial analysis has developed significantly on account of bigger complexity of business systems. Thus, the need for advanced calculations and used techniques has also increased. Conventionally, creditworthiness and other types of assessments have been done using various statistical methods and, in general, creditworthiness assessment has been a statistical category.

One of the most relevant issues in financial analysis is credit score calculation. A credit score is primarily based on a credit report information. Lenders, such as banks, use credit scores to evaluate the potential risk posed by lending money to companies. Lenders use credit scores to determine who qualifies for a loan, at what interest rate, and what credit limits.

To predict the model for credit score, there are number of techniques like: Statistical techniques, Neural Network, Genetic Algorithm, Fuzzy Logic and hybrid approaches, such as Neuro-Fuzzy. As it is fact that each technique has their own pros and cons.

In this paper, to create the prediction model for creditworthiness, Neuro-Fuzzy approach has been used, more specifically, an adaptive neuro-fuzzy inference system (ANFIS). Neuro-Fuzzy approach is applied because the combination of Neural Network and Fuzzy Logic results in such hybrid intelligent system that is having learning ability to optimize its parameters with the use of neural network and to represent the knowledge in an interpretable manner, with the use of Fuzzy System. Created system does not require an expert in finance.

Model in this paper is based on financial information, represented by 23 financial ratios, regarding 150 companies located in Serbia for the period 2011-2013. In order to optimize the given data set and reduce number of ratios, Principal Component Analysis is used.

The paper is structured as follows: Sections 2, 3, 4, 5 provide the basic concepts of Fuzzy Logic, Neural Networks, Neuro-Fuzzy Systems and ANFIS. Related work is given in Section 6. In Section 7 the concept of Principal Component Analysis is introduced. Section 8 is devoted to the experimental results and their analysis and finally, Section 9 concludes the paper and discusses future work.

2. FUZZY LOGIC

The theory of fuzzy sets was initiated by Lofti Zadeh in 1965. In his influential paper named Fuzzy Sets he pointed out that such imprecisely defined sets or classes “play an important role in human thinking, particularly in the domains of pattern recognition, communication of information, and abstraction” (Zadeh, 1965.).

Fuzzy set, as the name says, is a set without a crisp boundary. That is, the conversion from “belonging to a set” to “not belonging to a set” moves gradually, and this fine gradation is defined by membership functions that give

fuzzy sets adaptability in modeling, a concept similar to commonly used linguistic expressions, such as “the man is tall” or “he is driving quite fast”.

Definition of fuzzy sets and membership functions is:

If it is assumed that X is a collection of objects expressed generically by X, then a fuzzy set A in X is described as a set of ordered pairs:

$$A = \{(x, \mu_A(x)) | \forall x \in X\} \tag{2}$$

$\mu_A(x)$ is called the membership function (MF for short) of x in A The MF maps each element of X to a continuous membership value (or membership grade) between 0 and 1 (Jang & Sun,1995.).

2.1. Fuzzy rules and fuzzy models

The process of drawing conclusions based on fuzzy rules is called fuzzy inference and the system made of it is called Fuzzy inferencing system – FIS. A fuzzy if-then rule (fuzzy rule, fuzzy implication or fuzzy conditional statement) presumes the form

$$if\ x\ is\ A\ then\ y\ is\ B \tag{3}$$

where A and B are linguistic values described by fuzzy sets on universes of discourse X and Y, respectively (Jang & Sun,1995.).

Two kinds of Fuzzy logic systems (FLS), the Mamdani and the Takagi-Sugeno-Kang (TSK) FLSs are widely used and they are currently adopted by the scientific community. Mamdani FLS is an intuitive and numerical system that maps crisp (deterministic) inputs to a crisp output (Mamdani & Assilian, 1975). Takagi-Sugeno-Kang FLS is very similar to Mamdani FLS. It is a special FLS which is also characterized by *if-then* rules, but its consequent is a polynomial. Its output is a crisp value obtained from computing the polynomial output, so it does not need a defuzzification process (Sugeno & Kang, 1988.; Takagi & Sugeno, 1985.).

3. NEURAL NETWORK

Artificial neural networks generalize the mathematical models of the human cognition and neural biology. Artificial neural networks show the ability to learn from the environment in an interactive fashion and show remarkable abilities of learning, recall, generalization and adaptation in the wake of changing operating environments (Azam, 2000.). The simplest neural network model is called a perceptron which can be trained to discriminate between linearly separable classes. For more complex tasks of classification or regression, models with multiple layers of neurons are necessary. This artificial neural network model is generally referred to as a multi-layer perceptron (MLP). This architecture consists mainly of three types of neuron layers, namely input layer, hidden layer(s) and an output layer. The nodes in an input layer encode the data presented to the network for processing. These nodes do not process the information, but simply distribute the information to other nodes in the next layer. The nodes in the middle layers are called hidden nodes. These neurons provide the nonlinearities for the network and compute an internal representation of the data. The nodes in the output layer are referred to as output neurons: they encode possible desired values assigned to the input data. A typical multilayer perceptron neural network model is shown in Figure 1.

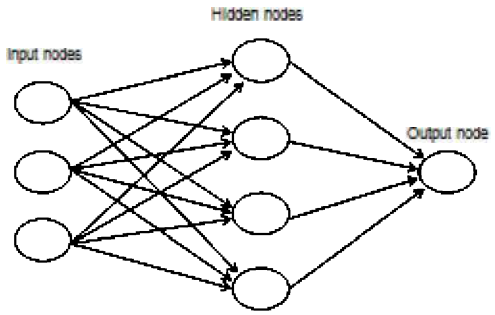


Figure 1: Artificial neural network

3.1. Neural network learning

Neural networks enable the intelligent processing without previosly defined model or algorithm, but based on information about particular system behaviour. Neural networks learn from experience. The process of learning is called training and it can be divided into three phases: calculating the output, comparing the obtained value with the desired value, adjusting the weight coefficients and going back to the first step. Learning algorithm that is mostly used is backpropagation algorithm. Neural network adjusts the weight coefficients according to error values assigned to each node. The calculating is done backwards, starting from the output layer to hidden layers and the process ends on the input layer. After the modification of parameters is completed, the process of training continues until the network is able to give outputs with a satisfying accuracy.

4. NEURO-FUZZY SYSTEMS

From the point when fuzzy systems started to be applied in industrial purposes, it has been clear that the progress of a fuzzy system that gives good results is not a simple task. The difficulties of defining membership functions and suitable rules is usually an exhausting process of tries and mistakes. Eventually the idea of combining learning algorithms with the fuzzy systems had been created. The neural networks, that have efficient learning algorithms, had been given as a solution to automate or to help the improvement of tuning fuzzy systems.

The combination of neural networks and fuzzy systems in order to join their good sides and to fix their separate flaws. Neural networks bring up their computational characteristics of learning in the fuzzy systems and take in from them the interpretation and the precision of systems representation. Thus, the parameters of the fuzzy systems can be fixed by the neural networks' competences. These concepts complement each other, which validates its use as a combination.

5. ANFIS

Adaptive neuro-fuzzy inference system (ANFIS) represents a multilayered adaptive network that uses fuzzy inference system with its membership functions. Adaptive neuro-fuzzy inference system's structure consists of network's directly connected nodes. Each node is defined by a function with adaptive or fixed parameters. Functions included in ANFIS build a fuzzy inference system using given input and output parameters. The ANFIS model uses Sugeno fuzzy inference system, and fuzzy if-then rules for describing complex system behaviour (Jang, 1992).

5.1. ANFIS architecture

ANFIS (Jang,1993) has an architecture that consists of five layers as shown in Figure 2. The first hidden layer is used for fuzzification of the input variables and T-norm operators are used in the second hidden layer to calculate the rule of the prior part. The function of the third hidden layer is to normalize the strengths of the rules. Next hidden layer is the place where the consequent parameters of the rule are concluded. Output layer estimates the total input as the incoming signals complete sum. ANFIS applies backpropagation learning algorithm in order to set parameters of the premise (to learn the parameters associated with membership functions) and least mean square estimation to determine the consequent parameters.

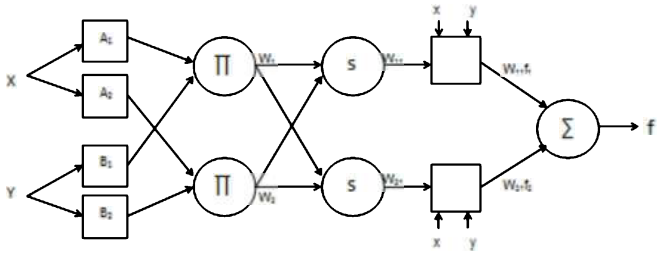


Figure 2: ANFIS architecture

6. PRINCIPAL COMPONENT ANALYSIS

The univariate statistical analysis, generally used to treat a large amount of data, could cause misunderstanding and error in the interpretation. In this paper, Principal Component Analysis (PCA) was used, in order to reduce the dimensionality problem. Highly dimensioned data set is reduced by explaining the correlation amongst a large number of variables in terms of a smaller number of underlying factors (principal components or PCs) without losing much information (Beatriz et al, 2000).

In fact, PCA creates linear combinations of variables. The first linear combination of variables is adequate for the most of the variation in the sample; the second combination is used for the second largest amount of variance in a dimension and there is no dependence between the first and the second combination; and so on (Petroni & Braglia, 2000). One of the advantages of the PCA methodology is to be quite simple to exploit. The analysis that is illustrated in the following has been carried out by using the SPSS computer package.

7. RELATED WORK

ANFIS has been very popular in solving many problems of financial nature, especially the ones dealing with some kind of prediction. (Trinkle, 2005) successfully anticipates stock prices at U.S. Stock Exchange Trade and (Chang et al, 2011) use ANFIS for anticipating stock prices trends and (Schott & Kalita, 2011) apply time series trends to Tehran stock exchange by combining ANFIS with three neural networks.(Ansari et al, 2010) use ANFIS for prediction of patterns and for trading support in financial markets. Combining ANFIS with KERNEL algorithm (Efendigil et al, 2009) predict emergency orders to pre-adjust the available capacity and production plan. Using ANFIS, satisfactory results were obtained in prediction of annual profits. (Abraham et al, 2001) (Efendigil & Önüt, 2012) used ANFIS for credit analysis.

(Bagheri et al, 2014) investigate the possibilities of particle swarm optimization (PSO) technique for determining the value of subtractive clustering parameters and ANFIS models for forecasting business failures based on five financial ratios. A new hybrid model that uses technical indicators as factors affecting the prediction and the use of three new methods (correlation matrix, subtractive clustering method and ANFIS) is proposed. (Melin et al, 2012).

8. MODEL DESCRIPTION

A credit score is a statistically derived numeric expression of a person's creditworthiness that is used by lenders to access the likelihood that a person will repay his or her debts. It is usually calculated using different complex statistical methods which require expert knowledge of financial concepts and elements that affect company's credit score. Knowing the disadvantages of the previously described approach, the idea of creating an ANFIS model for credit score calculation emerged as a logical response. In order to build the wanted system, the only necessary thing is an adequate database, while the system itself creates the neuro-fuzzy system that determines the credit score values. The experiment described in this paper is based on information regarding 150 companies settled in Serbia. All the information was obtained from Cube Risk Management Solution, a company that provides business information and credit risk services. The used database contains values of 23 financial ratios for each individual company for the period 2011-2013 and their credit score values in the same period.

Financial ratios represent relationships derived from a company's financial information and used for comparison purposes. In general, financial ratios can be divided into four main categories: profitability or return on investment, liquidity, leverage, and operating or efficiency, with several specific ratio calculations prescribed within each.

The main database provides information about following ratios: EBITDA margin, profit margin, net margin, return on assets, the operating cash flow ratio, quick ratio, return on equity, debt-to-equity ratio, fixed assets to equity ratio, long-term debt to total assets ratio, fixed assets to long-term liabilities ratio, amortization period for a loan, days sales outstanding, days payable outstanding, days inventory outstanding, cash conversion cycle, total assets turnover ratio, fixed assets turnover ratio, working capital turnover ratio, trend in income, EBITDA trend, working capital trend and short-term liability trend.

In order to reduce the dimensionality of the given data set and retain the most relevant information, the method of principal component analysis was applied.

8.1. Correlation between variables

PCA is based on the diagonalization of the correlation matrix. The observation of that matrix is useful because it can point out associations between variables that can show the global coherence of the data set (Beatriz et al, 2000). Table 1 shows the correlation matrix of the variables. Usually, significant correlations (at a P =0.05 level) are searched for. We can observe highest and positive correlations between credit score and six following ratios: net margin, profit margin, EBITDA margin, return on assets, the operating cash flow ratio and the quick ratio. Given correlation matrix shows that credit score is most correlated with EBITDA margin where the value of correlation coefficient is 0.529. In general, computed correlation indicates that the connection between credit score and presented financial ratios is not very strong.

Table 1: Correlation matrix

Ratio	1	2	3	4	5	6	7	8
1	1.000	0.913	0.732	0.578	0.336	0.382	0.423	0.529
2	0.913	1.000	0.846	0.620	0.386	0.394	0.436	0.497
3	0.732	0.846	1.000	0.683	0.410	0.474	0.518	0.490
4	0.578	0.620	0.683	1.000	0.761	0.223	0.229	0.465
5	0.336	0.386	0.410	0.761	1.000	0.049	0.068	0.183
6	0.382	0.394	0.474	0.223	0.049	1.000	0.909	0.222
7	0.423	0.436	0.518	0.229	0.068	0.909	1.000	0.201
8	0.529	0.497	0.490	0.465	0.183	0.222	0.201	1.000

1- EBITDA margin 2-Profit margin 3-Net margin 4- Return on assets 5- Return on equity 6- The quick ratio 7 -The operating cash flow ratio 8- Credit score

The main part of the PCA is creation of principal components. A rule-of-thumb for determining the number of components to extract is to consider the “eigenvalue greater than one” criterion (Petroni & Braglia, 2000).

In the present analysis, nine components are a workable solution (since the residual components have all eigenvalues less than 1). The first nine components account for approximately 75 percent of the total variance of the variables (Table 2).The percentage of variance explained by each component represents its relative importance.

Table 2: Total variance explained

Component	1	2	3	4	5	6	7	8	9
Initial Eigenvalues Total	4.702	2.788	2.286	2.078	1.773	1.289	1.131	1.051	1.016
% of Variance	19.591	11.618	9.526	8.658	7.388	5.371	4.712	4.380	4.232
Comulative %	19.591	31.208	40.735	49.393	56.781	62.152	66.864	71.244	75.476

Highest values of component loadings in each of the components, presented in the component matrix, belong to the following ratios respectively:

- **net margin** tells what percent of profit is made from sales (Griffin, 2009),
- **fixed assets to equity ratio** is computed by dividing the fixed assets by the company’s equity,
- **the cash conversion cycle (CCC)** is a net time-interval between actual cash expenditures on purchase of productive resources and the ultimate recovery of cash receipts from product sales (Ortín-Ángel & Prior, 2004),
- **total assets turnover ratio** measures a firm’s efficiency at using its assets in generating sales or revenue – the higher the number the better (Griffin, 2009),
- **the quick ratio** measures a company’s ability to meet its short-term obligations with its most liquid assets by subtracting inventory from total current assets (Griffin, 2009),

- **days sales outstanding** (DSO) gives a measure of the number of days it takes for the company's inventory to turn over, i.e. to be converted to sales. (Marr, 2012)

trend in income, EBITDA trend, working capital trend.

The first six variables were kept as the result of the principal component analysis whose purpose was the optimal reduction of the data set.

After creating a new data set that contains companies' information expressed with seven financial ratios including the credit score, the created data set was used for preparing inputs for ANFIS.

8.2. Data

In order to perform the ANFIS analysis, Matlab R2011 software was used and its neuro-adaptive learning techniques incorporated in the anfis command provided by the Fuzzy Logic Toolbox. Fuzzy inference system is formed with the process of training, done on input data. As a result, a single output values is obtained which represents the value of company's data score based on given inputs. In the process of testing the new, unlabeled data, the final task is comparing whether the output corresponds to the output of given data set.

The training set included information from 2011 and 2012, which involved 300 records, and the testing was done for the period of 2013, which involved 150 records.

Considering the nature of the problem, fuzzy inference system parameters were set:

- For each input three membership functions were assigned
- Membership functions are generalized bell curve (gbellmf)
- Membership type of the output was selected to be a constant, which means we made zero-order Sugeno model.

One of the chosen parameters for training the network was the hybrid method of optimization, i.e. a combination of the backpropagation algorithm and the least squares method. The process of training is done intwo phases. In the first phase, the least squares method is used for defining output membership functions which are positioned on the fourth layer of the ANFIS architecture model. In the second training phase, the backpropagation algorithm adjusts the parameters of input memebership functions.

The data set was divided into two subsets, one for the training part and one for the testing part. This was done in order to enable neuro-fuzzy model testing. Training data set was used for network learning and adjusting weights in network, while testing data set was used to test if the network was properly formed, based on new, unlabeled data. Initial data set was split with the ratio 70:30.

8.3. The experiment and the results

The first set used for training in ANFIS contained six inputs (net margin, fixed assets to equity ratio, the cash conversion cycle, total assets turnover ratio, the quick ratio and days sales outstanding) and one output (credit score). Training the FIS required approximately 90 minutes to be done. After testing the FIS and plotting the results against training data, relative error, regarding measured and actual credit score values, was calculated. It is expressed in percents and its value is 6.13%.

The second set used for training contained five inputs (net margin, fixed assets to equity ratio, the cash conversion cycle, total assets turnover ratio and the quick ratio). Training of this FIS lasted approximately five minutes and the value of calculated relative error after testing the FIS was 6.73%.

Data set that included four inputs (net margin, fixed assets to equity ratio, the cash conversion cycle and total assets turnover ratio) was used for training that demanded approximately one minute to be finished. After testing the FIS using the data set with the same four inputs and their values for the different period (2013), the value of the relative error was 6.81%.

With the final reduction of the number of inputs, data set with three inputs (margin, fixed assets to equity ratio and the cash conversion cycle) was created and used for training the FIS. The process of training required less than a minute to be completed. The difference between measured and actual values of credit score values after testing the FIS, expressed by the relative error, was 7.14%.

Comparing the results represented by time needed for training and the relative error values after the process of testing, the conclusion is that values of the relative error increase by reducing the number of inputs in a data set. By increasing the number of inputs, number of corresponding fuzzy rules also increases, and consequently, the total amount of stored data grows larger which leads to more time required for training the system. The chosen combination and the most satisfying by means of time and error is the one regarding four inputs.

Considering that there are three membership functions for each input, regarding the chosen model with four inputs, that means that $4^4 = 256$ if-then rules are defined, and therefore 256 output membership function are defined, too. Inside the fifth layer, the output value is defined as a constant and it represents the value of credit score. The process of training was done after 20 epochs, and the built network included 193 nodes and 117 parameters.

Figure 3 shows the correspondance between the actual and the measured values of credit score through the epochs after the process of testing was done. The circular points in blue color represent the testing data output and the star points in red color represents the predicted outputs of the trained FIS.

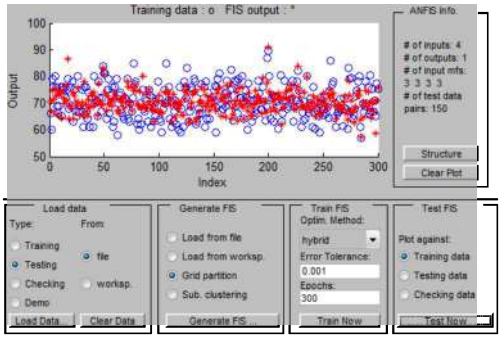


Figure 3: Testing error

The value of the relative error was not significantly increased in comparison to the error regarding the data set with five inputs. However, training required five times less time and that difference would be more evident for larger data sets. ANFIS model with three inputs completed its training process for significantly shorter period of time. However, the value of the relative error of the model is significantly higher, comparing to four-input model, for approximately 0.33% and that was the reason for not taking into consideration further input reduction.

9. CONCLUSION

Creditworthiness prediction is one of the most complex financial problems which commonly requires a thorough understanding of company's financial information and various statistical methods. Experts are always searching for simpler techniques that give satisfying results.

Neuro-fuzzy systems are used for exploiting the capacities of neural network learning in the best possible way in order to improve the fuzzy inference system performance. Additionally, fuzzy inference system represents the most important tool for modelling, based on the theory of fuzzy sets. The adaptive neuro-fuzzy inference system (ANFIS) is a good choice for modelling a system with already known inputs and outputs. Knowledge of the system and its processes is not necessary.

In this paper, authors formed an adaptive neuro-fuzzy inference system for determining credit score for 150 companies, based on values of financial ratios for a two-year period. The system was trained and tested. After doing a comparative analysis regarding system's performance by changing number of inputs i.e. ratios in the initial data set, it was concluded that data set with four inputs (net margin, fixed assets to equity ratio, the cash conversion cycle, total assets turnover ratio) gives the best results, by means of time needed, the amount of data and error in prediction. Hence, it can be concluded that ANFIS applied on the problem of creditworthiness assessment gives satisfying results in reasonable time.

In future work, it would be interesting to explore and apply other neuro-fuzzy models or different network learning algorithms in order to examine the possibility of obtaining more accurate results or less time for the process of training the network.

REFERENCES

Abraham, A, Nath, B & Mahanti, P.K. (2001). Hybrid intelligent systems for stock market analysis. *Computational Science*, 2074, 337-345.

Ansari et al.. (2010). Sequential combination of statistics, econometrics and Adaptive Neural-Fuzzy Interface for stock market prediction. *Expert Systems with Application*,37(7), 5116-5125.

Azam F. (2000) Biologically inspired modular neural networks. Ph.D. dissertation. Submitted to Virginia Polytechnic Institute and State University.

Bagheri, A, Mohammadi peyhani, H & Akbari, M. (2014). Financial forecasting using ANFIS networks with quantum-behaved particle swarm optimization. *Expert Systems with Application*, 41(14), 6235-6250.

Beatriz et al.. (2000). Temporal evolution of groundwater composition in an alluvial aquifer (Pisuerga River, Spain) by Principal Component Analysis. *Water Research*,34(3), 807-816.

Chang, J, Wei, L & Cheng, C. (2011). A hybrid ANFIS model based on AR and volatility for TAIEX forecasting. *Applied Soft Computing*, 11(1), 1388-1395.

Efendigil, T & Önüt, S. (2012). An integration methodology based on fuzzy inference systems and neural approaches for multi-stage supply-chains. *Computers & Industrial Engineering*, 62(2), 554-569.

Efendigil, T, Önüt, S & Kahraman, C. (2009). A decision support system for demand forecasting with artificial neural networks and neuro-fuzzy models: A comparative analysis. *Expert Systems with Application*, 36(3), 6697-6707.

Griffin, M. .P. (2009). *MBA Fundamentals Accounting and Finance*. : Kaplan Publishing.

Jang J.S.R. (1992) Neuro-Fuzzy Modelling:Architectures, Analysis and Applications, PhD Thesis, University of California, Berkley

Jang J. S. R. (1993) ANFIS: adaptive-network-based fuzzy inference system, IEEE transaction on Systems, Man and Cybernetics, 23 (3), 665–685.

Jang J.S.R. and Sun, C.T. (1995) Neuro-Fuzzy Modeling and Control, Proc. IEEE, Special Issue on Engeneering Applications od fuzzy logic, 82(3),1-30.

Mamdani E. H., Assilian S. (1975) An experiment in linguistic synthesis with a fuzzy logic controller, International journal of man-machine studies, 7(1), 1-13.

Marr, B. (2012). *Key Performance Indicators*. : Financial Times Publishing.

Melin et al.. (2012). A New Approach for Time Series Prediction Using Ensembles of ANFIS Models. *Expert Systems with Application*, 39(3), 3494-3506.

Ortín-Ángel, P & Prior, D. (2004). Accounting turnover ratios and cash conversion cycle. *Problems and Perspectives in Management*, 2(1), 189-205.

Petroni, A & Braglia, M. (2000). Vendor Selection Using Principal Component Analysis. *The Journal of Supply Chain Management*, 36(2), 63-69.

Schott, J & Kalita, J. (2011). Neuro-fuzzy time-series analysis of large-volume data. *Intelligent Systems in Accounting, Finance and Management*, 18(1), 39-57.

Sugeno M., Kang G. T. (1988) Structure identification on fuzzy model, Fuzzy sets and systems, 28, 15-33.

Takagi T., Sugeno M. (1985) Fuzzy identification of systems and its applications to modeling and control, IEEE Transactions on Systems, Man and Cybernetics, 15, 116-132.

Trinkle, B. .S. (2005). Forecasting annual excess stock returns via an adaptive network-based fuzzy inference system. *Intelligent Systems in Accounting, Finance and Management*, 13(3), 165-177.

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

OPTIMIZATION OF ATM CASH MANAGEMENT

Nela Milošević*[1], Dragana Makajić Nikolić[1], Sladjana Barjaktarović Rakočević[1]
[1] Faculty of Organizational Sciences
* Corresponding author, e-mail: nela.milosevic@fon.bg.ac.rs

Abstract: *Having in mind recent financial crisis and liquidity shortages which banks have to face on regular basis, bank liquidity management has become one of the main concerns within this industry. Automated mathematical solutions accurately predict currency supply and demand and this may enable banks to reduce costs, especially costs of keeping significant exceptional sum of money in ATMs. In today's business environment which is characterized by tremendous competitiveness and globalization of business, cash management has become a critical success factor. Despite comprehensive literature reviews on similar topics, studies focused on cash management in ATMs in Serbia are still at the initial phase. This paper aims to decide on the optimal amount of money that will be placed in an ATM for minimizing opportunity costs as well as meeting clients' daily uncertain demands. The biggest challenge for this study is to calculate the amount of money that is sufficient to provide services to ATM customers and small enough to avoid any losses to the bank due to holding too much cash in the ATM. The study offers quality basis of information for banks and academics. The results we have obtained clearly show that the costs which arise when the ATM is filled to the optimal amounts of money are lower than those if the ATM is at full recommended value.*

Keywords*: Bank cash management, ATMs, optimization*

1. INTRODUCTION

Banks are nowadays willing to reduce liquidity tensions and optimize all functions having impact on liquidity management. Despite the fact that every model has its imperfections, banks put a lot effort to improve distribution channels in order to reduce liquidity tensions. In order to meet their customers' demand, banks have created extensive cash outlet networks, which consist of both bank branches and automatic teller machines (ATMs). ATM is a computerized telecommunication device that provides a financial institution's customers a method of financial transactions in public space without any human support needed (Simutis et al., 2015). Cash management in ATMs is certainly among activities that can make difference within tight competition in banking. Purpose of this paper is to decide on the optimal amount of money that will be placed in an ATM, which is placed within bank office, for minimizing opportunity costs as well as meeting clients' daily uncertain demand. The biggest challenge for this study is to calculate amount of money sufficient to provide service to ATM customers and small enough to avoid any losses to the bank due to the fact of holding too much cash in the ATM. This surplus could be used for generating money when invested in other bank products such as bills, certificates of deposits, commercial paper and any other money bank instruments.

Banks are now thinking from the customer's point of view and trying to bring most services door to door. Efficient bank cash management guarantees effective collection and payment technique, proper disbursements of free funds, and help for urgent cash requirement. The problem of cash management in automatic teller machines (ATMs) is similar to cash management in branches. These problems are characteristic for every bank and have to be analyzed according to future unknown probabilistic demand. In a very competitive bank market in Serbia, decision support systems for liquidity management activities in banking can make a significant difference within banks. In general, cash management in ATMs (and similarly in branches) is a well-known problem faced by any bank, hence worth researching.

This paper is structured as follows: in section 2, literature overview is presented; In section 3, cash management in ATMs is discussed; In section 4, methodology is defined; In section 5, some experimental results are presented and analyzed, followed by conclusions and future work.

2. LITERATURE OVERVIEW

Having in mind recent financial crisis and liquidity shortages which banks have to face on regular basis, bank liquidity management has become one of the main concerns within this industry. Numerous researchers have brought about significant improvements in cash management, which began by Baumol (1952) and

Tobin (1956), continued with Miller and Orr (1966) and more recently with Roman and Sargu (2014) who presented the research with the aim to evaluate the liquidity risk of banks operating in Bulgaria and Romania in the context of the EU affiliation process. The authors have investigated role and impact that a series of financial indicators for the capital adequacy, assets quality, management quality and profitability have on the liquidity risk of the banking institutions. Vuillemey (2014) in his paper made a conclusion that the increase in banks' probabilities of default in most banking sectors in the Euro area during the latest financial crisis is mostly attributable to liquidity risk.

In addition, DeYoung and Jang (2015) have conducted research 'Do Banks Actively Manage their Liquidity?' Authors have been testing whether and how US commercial banks actively managed their liquidity positions between 1992 and 2012 and made conclusion that as banks increase in size, they set lower liquidity targets, but manage those targets more efficiently.
Ekinci et al. (2015) have been focused on one of the main banking goals: how to use fewer resources (e.g. cash kept in ATMs, trucks for loading cash, etc.) for meeting fluctuating customers' demands. Their article proposes grouping ATMs into nearby-location clusters and also optimizing aggregates of daily cash withdraws in order to minimize costs of replenishing cash, cash-interest charge and potential customer dissatisfaction. Venkatesh et al. (2014) have built a time series model for each ATM by analyzing prediction of cash demand for groups of ATMs with similar day-of-the week cash demand patterns. The main conclusion of their research is that the cluster wise cash demand forecast helps the bank's top management to design similar cash replenishment plans for all the ATMs in the same cluster. This means that banks can optimize operational costs geographical regions. Yan et al. (2015) have proposed a daily vehicle routing model for minimizing the total cost of replenishing inventory within a supply chain. Scholtz et al (2013) have done a case study for Orion in order to solve the cash management problems of ATMs with stochastic discrete-event simulation in retail banking. Their decision support system integrates four Operations Research methods: the vehicle routing problem, the continuous review policy for inventory management, the knapsack problem and stochastic, discrete-event simulation. The results have shown that the use of vehicle routing methods is especially useful when the bank has substantial control over transportation cost. According to Teddy and Ng (2011) conventional global learning computational intelligence models may not be efficient enough in order to record complex and time-varying characteristics of time series data. The authors have proposed a new model - cerebellar-inspired associative memory network, which can produce accurate forecasts of ATM cash demands.

On the basis of what we have described above, one may conclude that liquidity management is a very comprehensive topic, analysis of which may hugely contribute to health and quality of the overall banking sector. ATM cash management has been an integral part of bank management mechanism asking for a clearly defined steps aiming at enhancement. One approach to this problem solution will be elaborated on in the next part of this paper, nonetheless there are undoubtedly many research issues that would be worth analyzing in the future.

3. CASH MANAGEMENT IN ATMs

It is widely believed that advanced operational research methods can optimize demand forecasting and contribute to proactively currency management. Automated mathematical solutions accurately predict currency supply and demand and this may enable banks reduce costs, especially costs of keeping significant exceptional sum of money in ATMs.

Serving ATMs network takes employees' time to optimize the network and make decisions about cash management. Moreover, it involves high operating costs and needs proper currency management in order to avoid having cash in ATMs. In a very competitive market, banks are willing to provide the most efficient way for cash management. Transportation and servicing costs are of a great interest within banking industry. As previously said, banks can conduct work itself or they can hire companies specialized for money transportation and filling of ATMs. Either way banks need an effective tool that determines the lowest cost of distribution. These tools are based on accurate supply and demand forecasting and optimization procedures with the aim to lower operational expenses and enhance return on cash assets.

Historical demand by using data from actual cash-in transactions and cash-out transactions is a starting point for every research on cash management in ATMs. Only when precise currency demand is defined it is possible to create software for monitoring, management and optimization of the ATM network. It is very important to have in mind that demand depends on additional factors, such as paydays, holidays, and seasonal demand in a specific area. Analytical models should be developed according to experience of the bank's daily operations, as well as additional events that occur under certain conditions. Procedures to determine the optimal cash demand for each ATM is the same regardless of most known solutions for ATM

network cash management. Firstly, based on the daily cash demand, transport and money upload costs should be calculated. Usually cash drawings are subject to trends and generally follow weekly, monthly and annual cycles. It is noticed that people draw relatively large sums of cash at the beginning of each month as well as before Christmas. ATMs placed in shopping centers are mostly used on Fridays and Saturdays. During summer holidays drawing rates decline considerably.

4. METHODOLOGY

In this paper, we consider ATM Cash Management as a newsvendor problem i.e. single period stochastic inventory problem. The newsvendor problem is related to the situation in which a decision maker needs to order a quantity of some goods each day in the circumstances of uncertain demand (Phillips, 2005). Three main characteristics of the newsvendor problem are (Brandimarte & Zotteri, 2007): a) it observe single-product and single-period and single-echelon inventory problem; b) demand is uncertain and its distribution is known; c) the objective is to minimize expected overall costs consisting the excess costs and the shortage costs i.e. costs of purchasing too many and too few.

Considering the previous characteristics, replenishment of ATMs can be formulated as a newsvendor problem: decision makers need to determine an amount of single product - cash for ATM refilling each day; daily cash demand is uncertain; excess and shortage of cash in ATMs entail certain costs. In order to formulate ATM Cash Management as a newsvendor problem, the following notation will be used (Krcevinac et al, 2004; Shapiro & Dentcheva, 2014)):

- c_h - excess cost per units expressed through the opportunity costs;
- c_p - shortage cost per unit;
- x - daily cash demand;
- Q - amount of cash stocked in ATM.

Overall daily cost depending on daily demand and amount of cash in ATM can be expressed as:

$$C(Q,x) = c_h(Q-x)^+ + c_p(x-Q)^+ \tag{1}$$

where $(Q-x)^+ = \max\{(Q-x),0\}$, $(x-Q)^+ = \max\{(x-Q),0\}$.

Since cash demand is uncertain, the expected overall costs are:

$$c(Q) = E[C(Q,x)] = c_h\int_0^Q (Q-x)\varphi(x)dx + c_p\int_Q^\infty (x-Q)\varphi(x)dx \tag{2}$$

where $\varphi(x)$ is demand probability density function and $\Phi(x)$ is cumulative distribution on demand.

Optimal Q^* that minimize expected overall cost $C(Q)$ satisfies:

$$\Phi(Q^*) = \frac{c_p}{c_p + c_h} \tag{3}$$

Therefore, the goal is to find Q^* such that:

$$Q^* = \Phi^{-1}\left(\frac{c_p}{c_p + c_h}\right) \tag{4}$$

The main prerequisite for the application of the proposed approach is the existence of data about demand for cash in the previous period. If data is available, the methodology for optimal ATM Cash Management introduced in this paper can be conducted through the following steps:

1. Separation of demand by date and removing outliers from datasets. The assumption of the proposed methodology is that the cash demand is similar within the same date, notwithstanding the month. However, certain deviation can appear. For instance, demand might depend on additional factors, such as paydays, holidays, and seasonal demand in a specific area. Consequently, outliers should be removed from obtained datasets.
2. Grouping of data by average demand similarity.
3. Determination of the probability distribution of demand for each obtained data group.
4. Determination of the opportunity costs and shortage cost per unit.
5. Calculation of optimal using equation (4) the expected overall cost.

5. FINDINGS AND DISCUSSION

The model which is presented in this paper is tested against real data. The ATM, which was observed is located within the branch and current practice is that once per day the manager checks the status of the cash in the ATM. The manager devotes a part of their time to this activity and risks their own safety as well as the security of the money. As well, it was observed that there is a need for systematization, because there is the opportunity cost of holding excess cash. In addition, the bank has no record of the cost penalty in terms of the number of clients who were planning to withdraw money, but they could not due to lack of cash in the ATM. To always be on the safe side, banks deposit more cash than necessary in ATMs and thereby miss an opportunity to make a profit, in other words they have the opportunity costs of holding excess cash. To test the model we had data on demand from 1.1.2013 until 31.12.2015. The results are presented according to the steps described in the previous part of this paper.

5.1. Steps 1 – 3

After separating the demand by date and removing outliers, average demands by dates are obtained. The values shown in Figure 1 are expressed in thousands of RSD.

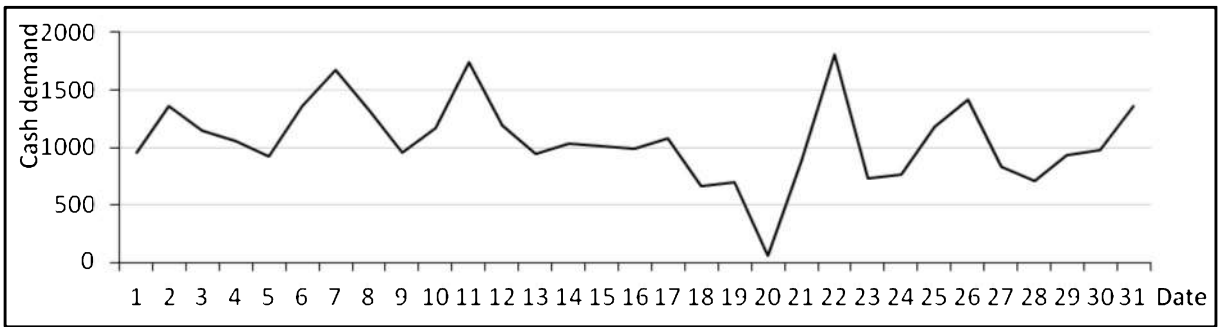


Figure 1: Average cash demands by dates

In an interview with bankers we came to the conclusion about the key dates for withdrawing money from ATMs 9 and 24, due to the pensions that were received on those days, as well as the salary received by the Serbian military on the 5th and 21st. In addition, the Serbian Ministry of Interior receives their salaries on the 10th and 25th of each month. The previous graph shows peaks in the average demand on those dates.

Based on the obtained average values and their similarities, six groups of dates are created. Dates that belong to each group as well as the average demands and demand probability density functions with corresponding parameters are listed in Table 1.

Table 1: Groups of dates and corresponding demand probability density functions

Group	Dates	Average	Probability distribution
1	7,11,22	1725.673	GenExtreme (0,02953; 493,26; 1426,1)
2	2,6,8,26,31	1392.737	Cauchy (295,47; 1361,7)
3	3,4,10,12,14,15,17,25	1102.875	Cauchy (644,6; 1155,6)
4	1,5,9,13,16,21,27,29,30	941.161	Cauchy (689,08; 946,34)
5	18,19,23,24,28	716.082	Frechet (0,27993; 0,82341; 0,49142)
6	20	57.386	Cauchy (0,0919; 0,77301)

5.2. Steps 4 and 5

Excess cost per units is expressed through the opportunity costs. Depending on the strategy of the bank, the most profitable form of investment of surplus cash is chosen. Some banks invest in over-night deposits, others lend cash to other banks, while some invest in government securities. After talking with experts from the bank we came to the conclusion that it would be optimal to use the value of the repo rate of the National Bank of Serbia as an opportunity cost, given that it is usually the rate used in pricing of deposits and loans.

The analysis of the average repo rate during the past year, the value for the parameter is estimated to be 0.0329. Since the shortage cost per unit could not be precisely determined, we examined two scenarios: the first one involves the same importance of excess and shortage of cash in ATMs while the second one considers the shortage more significantly than excess of cash. Scenarios characteristics are as follows:

- Scenario 1: $c_p = c_h = 0.0329$. By applying equation (3) it follows that $\Phi(Q^*) = 0.5$.
- Scenario 2: $c_p = 2 \cdot c_h = 0.0658$ and $\Phi(Q^*) = 0.6667$.

The optimal amounts of cash that should be stocked in an ATM are shown, each group of dates are calculated using equation (4) and based on corresponding probability function from Table 1. Summarized results are shown in Table 2 (expressed in thousands of RSD).

Table 2: Optimal amounts of cash for an ATM

	Q*	
Group	cp=ch	cp=2ch
1	1607.9	1877.5
2	1361.7	1532.3
3	1155.6	1527.8
4	946.34	1344.3
5	3.541	21.209
6	0.77301	0.82609

As expected, the obtained optimal amounts of cash are higher in the second scenario because higher shortage cost leads to higher probability of optimal amount and, consequently, higher optimal amount of cash for an ATM. Comparing these values with the average values from Table 1, it may be noted that the optimal values in the first scenario are mostly lower than average while those in the second scenario are higher than average.

In order to evaluate the proposed methodology, we have compared overall expected costs based on the optimal solution with overall costs caused by the application of the bank's replenishment policy. It is recommended for bankers to fill ATMs with 1.7 million RSD on weekdays and 2.5 million RSD on weekends. Since those amounts were determined based on historical data and insufficient analysis, we saw the space to create a model that would be able to more reliably predict the optimum quantity for refilling ATMs. Also, in order to compare the results in this paper we have used the recommended amount of 1.7 million RSD because the days of the weekend were excluded from the analysis. The ATM that we observed is distinctive because it is part of the branch that does not work on Sundays and Mondays.

Table 3 shows the overall expected costs for scenarios 1 and 2. Rows 1(opt) and 1(1700) are related to the Scenario 1 and give costs per group of dates and total costs if amounts of cash that should be stocked in an ATM were optimal and 1700, respectively. Rows 2(opt) and 2(1700) contain the same data for Scenario 2. Costs are calculated for each day of the entire period using the equation (1) and summarized by corresponding groups of dates.

Table 3: Overall expected costs

	group						
scenario	1	2	3	4	5	6	total
1 (opt)	857.606	1810.741	4871.345	5007.249	2661.637	33.611	15242.190
1 (1700)	867.934	2153.240	5852.324	6389.690	4519.970	972.756	20755.913
2 (opt)	1333.011	2622.292	6799.877	6638.002	5305.919	67.170	22766.272
2 (1700)	1325.129	2744.631	6980.933	7200.299	4950.999	972.756	24174.746

The same results are graphically presented in Figure 2.

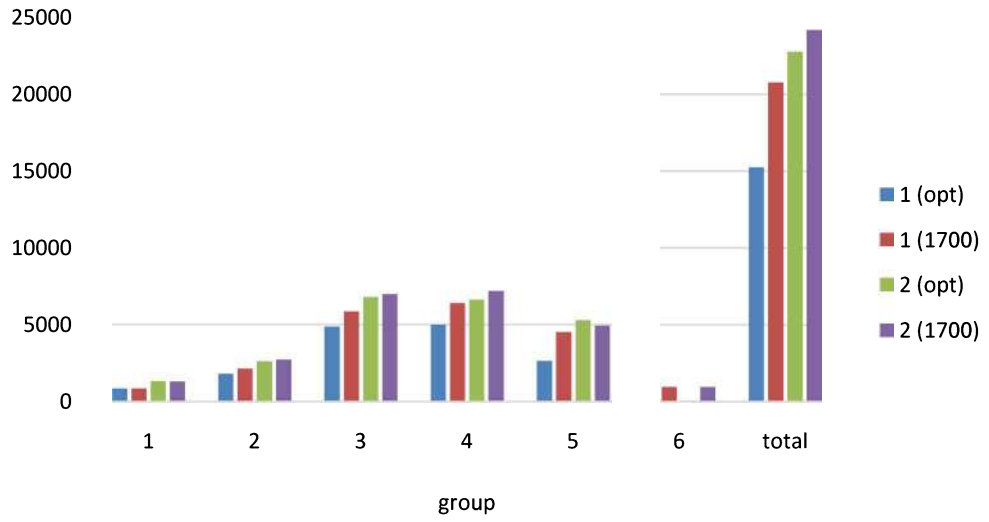


Figure 2: Overall expected costs comparison

In both variants it shows amount of cash that should be stocked in an ATM (optimal and 1700), the overall costs in Scenario 2 are higher than those in Scenario 1 due to the higher shortage costs. In addition, the optimal amounts of cash are higher. However, in both scenarios, the overall costs with optimal amounts are lower than corresponding costs with bank replenishment policy, separately per groups and in total. Furthermore, optimal costs in Scenario 2 – 2(opt) are not significantly higher than the bank policy cost in Scenario 1 – 1(1700) although they have higher shortage cost. The results show that it is better to stock the ATM with the amount of cash corresponding to the expected demand for that date than the same amount every day. The selection of scenarios that will be applied depends on the attitude of decision makers to the excess and shortage of cash in the ATM.

6. CONCLUSION

On the basis of what we have described above, one may conclude that liquidity management is a very comprehensive topic, analysis of which may hugely contribute to health and quality of the overall banking sector. ATM cash management has been an integral part of the bank management mechanism asking for clearly defined steps aiming at enhancement.

The purpose of this paper is to decide on the optimal amount of money that will be placed in an ATM for minimizing opportunity costs as well as meeting clients' daily uncertain demands. The biggest challenge for this study is to calculate the amount of money that is sufficient to provide services to ATM customers and small enough to avoid any losses to the bank due to the fact of holding too much cash in the ATM. The study offers quality basis of information for banks and academics. The results we obtained clearly show that the costs which arise when the cash dispenser is filled to optimal amounts of money is less than the costs that arise if the ATM is at full recommended value of 1.7 million RSD. The selection of scenarios that will be applied depends on the attitude of decision makers to the excess and shortage of cash in the ATM. The conclusion of the investigations show that improving systems and procedures in the bank should be worked on.

The study incorporates both quantitative and qualitative data on cash management for ATMs, the basic limitations are related to the assumptions that we have made in terms of opportunity cost and shortage cost of cash in the ATM. In addition, the test model used is one particular bank ATM. However, the limitation of the analysis provide interesting research directions to further investigate models for improving cash management in ATMs. The models for cash management in ATMs can be extended in several ways to fit the particular banking reality. For example, the model could be applied to different ATMs in order to observe the group results and the results of each ATM. Moreover, more attention can be devoted to the cost structure, which was analyzed in terms of representation of the various opportunity costs and shortage costs that arise if there is insufficient cash in an ATM.

REFERENCES

Baumol, W. J. (1952). The transactions demand for cash: An inventory theoretic approach. *The Quarterly Journal of Economics*, 545-556.

Brandimarte, P., & Zotteri, G. (2007). *Introduction to distribution logistics*(Vol. 21). John Wiley & Sons.

DeYoung, R., & Jang, K. Y. (2015). Do Banks Actively Manage their Liquidity?. Journal of Banking & Finance. doi:10.1016/j.jbankfin.2015.11.013

Ekinci, Y., Lu, J. C., & Duman, E. (2015). Optimization of ATM cash replenishment with group-demand forecasts. Expert Systems with Applications, 42(7), 3480-3490. doi:10.1016/j.eswa.2014.12.011

Krcevinac, S., Čangalović, M., Kovačević-Vujčić, V., Martić, M., Vujošević, M. (2004) Operations Research. FON. Belgrade (In Serbian)

Miller, M. H., & Orr, D. (1966). A Model of the Demand for Money by Firms. *The Quarterly journal of economics*, 413-435.

Phillips, R. L. (2005). *Pricing and revenue optimization*. Stanford University Press.

Roman, A., & Sargu, A. C. (2015). The Impact of Bank-specific Factors on the Commercial Banks Liquidity: Empirical Evidence from CEE Countries. Procedia Economics and Finance, 20, 571-579. doi:10.1016/S2212-5671(15)00110-0

Scholtz, E., Bekker, J., & Du Toit, D. (2013). Multi-objective optimisation with stochastic discrete-event simulation in retail banking: A case study.ORiON: The Journal of ORSSA, 28(2), 117-135. http://dx.doi.org/10.5784/28-2-116

Shapiro, A., & Dentcheva, D. (2014). *Lectures on stochastic programming: modeling and theory* (Vol. 16). SIAM.

Simutis, R., Dilijonas, D., Bastina, L., Friman, J., & Drobinov, P. (2015). Optimization of cash management for ATM network. Information technology and control, 36(1).

Teddy, S. D., & Ng, S. K. (2011). Forecasting ATM cash demands using a local learning model of cerebellar associative memory network. International Journal of Forecasting, 27(3), 760-776. doi:10.1016/j.ijforecast.2010.02.013

Tobin, J. (1956). The interest-elasticity of transactions demand for cash. *The Review of Economics and Statistics*, 241-247.

Venkatesh, K., Ravi, V., Prinzie, A., & Van den Poel, D. (2014). Cash demand forecasting in ATMs by clustering and neural networks. European Journal of Operational Research, 232(2), 383-392. doi:10.1016/j.ejor.2013.07.027

Vuillemey, G. (2014). Epistemological foundations for the assessment of risks in banking and finance. *Journal of Economic Methodology*, *21*(2), 125-138. doi:10.1080/1350178X.2014.907438

Yan, S., Chu, J. C., Hsiao, F. Y., & Huang, H. J. (2015). A planning model and solution algorithm for multi-trip split-delivery vehicle routing and scheduling problems with time windows. Computers & Industrial Engineering,87, 383-393. doi:10.1016/j.cie.2015.05.034

DRIVERS OF HOTEL PROFIT MARGINS: A STUDY OF THE BELGRADE HOTEL SECTOR

Miloš Milosavljević*[1], Nemanja Milanović[1], Slađana Benković[1]
[1]University of Belgrade, Faculty of Organizational Sciences
*Corresponding author, e-mail: milosavljevic@fon.bg.ac.rs

Abstract: *Tourism and hospitality have received an immense attention from scholars, policy holders, decision makers and other important stakeholders in Belgrade, a main tourist destination of Serbia. The aim of this paper is to analyze different drivers of profitability, such as size, market concentration, market share and customer perception, that affect the profitability of hotels in Belgrade. The results indicate that customer perception is a paramount factor driving the financial performance of hotels.*

Keywords*: profit margin, hotels, customer perception, Belgrade*

1. INTRODUCTION

Tourism and hospitality industry has been highly on the agenda of policy holders and decision makers in Serbia (Milosavljević, Milanović & Benković, 2015), particularly in Belgrade as it accounts for the majority of arrivals and nights of tourists in Serbia. The rationale for this is the high impact of tourism to the economic development of the Belgrade region and the economy as a whole. Academic publications almost equally intensively elaborate on the importance of tourism, the sources of development, the features of processes in the industry and its economic effects (Dimitrovski, Todorović & Valjarević, 2012; Mulec & Wise, 2013). However, there is a paucity of scholarly contribution to the origins of financial performance of the Belgrade's hotel sector, and the main drivers of its profitability.

This research gap sets a scene for the main aim of this paper. The aim is to analyze different drivers of profitability, such as size, market concentration, market share and customer perception, that affect the profitability of hotels in Belgrade. In particular, the study aims to test the influence of 10 different factors to determine their correlation to the hotels' financial performance, and

The studies of this kind are a hot topic in academic and practitioners' publications. For instance, Ben Aissa & Goaied (2016) empirically tested the main determinants of 27 Tunisian hotels. Lado-Sestayo et al. (2016) conducted a study encompassing nearly 9000 hotels in Spain to test the impact of location on profitability in the Spanish hotel sector. However, the originality of this study is based on two important pillars. Firstly, to the best of authors' knowledge, the study is unique in this geographical region. Some aspects of the Belgrade hotel sector, such as the change in offer have been discussed in the extant literature (Šimičević & Štetić, 2015), but non of the papers dealt with the profitability of the sector. Secondly, the study is unique in the developed set of indicators selected as the main drivers of profitability

The remainder of the paper is organized as follows. Section 2 deals with theoretical background. Particular emphasis is given to the business case for hotel industry in Belgrade. Section 3 elaborates on the methodology used in the study. Section 4 depicts the results and discusses the main findings. Section 5 provides concluding remarks, dealing with the resume of key findings, managerial and other implications, limitations and further recommendations.

2. THEORETICAL BACKGROUND

2.1. Profitability drivers in hotel industry

Profitability drivers are frequently elaborated in the extant literature. Ever since the pioneering attempts of Kotas (1982), Sheldon (1983) and Croston (1995) researches have been examining various determinants of profitability striving to find the best methodology for analysis of financial operations and appropriate business strategy. Currently, several streams of publications regarding the set of variables selected as the main determinants of profitability are specifically important.

The first stream are scholarly publications emphasizing the importance of market power, location and concentration. Singh & Dev (2015) have analyzed hotels as winners and losers in the aftermath of the recession, suggesting that marketing expenses play an important role in financial success. Lado-Sestayo et al. (2015) explored the influence of location, market power and other factors to the profitability of the Spanish hotel sector. They find that profitability depends largely on the market structure and the level of demand of the tourist destination.

The second stream are the papers dealing with operational and financial efficiency. Zeglat (2008) finds that profitability is positively influenced by sales growth, as a consequence of customer retention, and negatively influenced by premium price by analyzing the UK hotel sector. Chiu and Huang (2011) analyzed the effects of occupancy rate and operational efficiency on profitability of Taiwanese hotels and found that occupancy rate and increase in sales are not the best way to increase financial performance. This is not in line with the main findings of O'Neill & Ma Instead, they suggested optimal occupancy rate and focus on operational efficiency. Another study from the same country deals with the effects of service quality, and indicates that, for instance, food and beverage quality has non-linear relationship with profitability (Chen & Lin, 2012). In the example of Croatian hotel industry, Škuflić & Mlinarić (2015) find that size, concentration, liquidity, solvency and productivity significantly affect hotel profitability.

The third stream are studies examining the role of online hotel presence and the effects of social media on hotel performances. The results are to some extent adverse. For instance, Neirotti, Raguseo, & Paolucci (2016) find that the increasing importance of user-generated reviews in online communities for tourists is "shifting hotel competition from unit profit margin to volumes and to higher room occupancy rates, with online retailers capturing most of the value created in online transactions through social media features and with a limited effect brought on net profitability". Using a more sophisticated approach of neural networks, Phillips et al. (2015) the interactive effects of online reviews on the determinants of Swiss hotel performance, finding a positive effect of four nodes to a hotel performance.

Some studies do not fit into this three-stream pattern. Certain studies address macroeconomic features and their influence over the profitability (Pan, 2005). On the other side, a broad body of evidence takes into consideration the human factor as an important pillar of the profitability. For instance, Morey & Ditman (1995) examined the effects of general managers efficiency to the hotel profitability. Finally, profitability is examined through the prism of long term yields generated from the adequate customer profitability analysis (Noone & Griffin, 1999).

2.2. A short business case for hotel sector in Belgrade

Belgrade accounts for more than a third of all tourist capacities of Serbia, which puts a spotlight to the importance of this industry to the total economic output of the country. Belgrade is the most important tourist destination in Serbia. The following figures illustrate the portion of total arrivals and nights of tourist in Serbia and in Belgrade in specific (RZS, 2015).

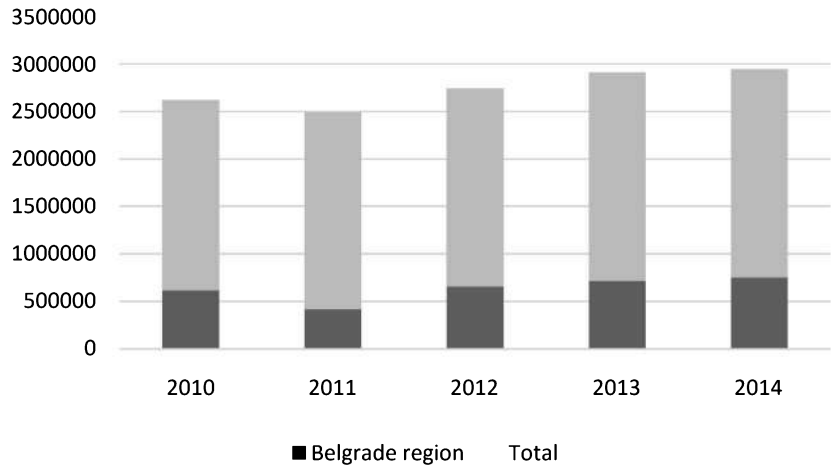


Figure 1: Total arrivals of tourists in Serbia and in Belgrade

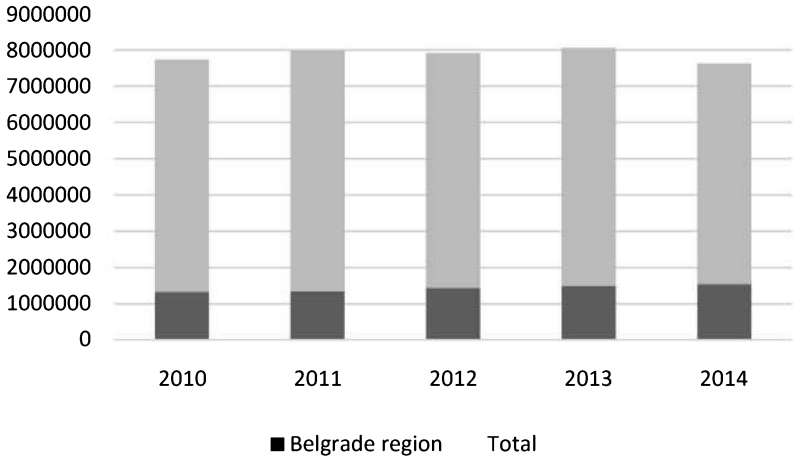


Figure 2: Total nights of tourists in Serbia and in Belgrade

According to Horwath (2015), internationalization of the demand profile is evident, followed by permanent increase in the relative share of foreign hotel overnights in total overnights. This study points out the international demand as a primary source of demand for Belgrade hotels, with annual growth rate of 10% (2009-2014).

3. METHODOLOGY

3.1. Variables

The study used one dependent and 10 independent variables. They are summarized in the table below:

Table 1: Variables, variable type, indicators, calculations and hypothesized influence over dependent variable

Variable	Type	Indicator	Calculation	Hypothesized influence (+/-)
Hotel profitability	Dependent	Profit margin	EBIT/Revenue	n/a
Location	Independent	Distance from three focal points – city center, central bus station and airport	(Dcen+Dbus+Dair)/3	+
Market power	Independent	Market share (revenue based)	Net revenue for a hotel/Total revenue for industry	+
Economy of scales	Independent	Size	Natural logarithm of hotel assets	+
Financial structure	Independent	Financial leverage	Liabilities/Equity	-
Social reach	Independent	Social media reach	No of Facebook page likes	+
Customer satisfaction	Independent	Aggregate hotel ranking	Booking.com ranking	+
Word-of-mouth	Independent	Net promoter score	Highest to lowest ranks of customers	+
Margins	Independent	Net margin	Net income/Revenue	+
Capacity	Independent	Total accommodation share	No of beds of a hotel/No of beds of all hotels	+
Hotel rating	Independent	Category of a hotel	No of stars	+

3.2. Sampling and data collection

The study examined 42 hotels located in the city area of Belgrade. The sample was randomly generated from the total of 530 hotels.

The study is based on secondary data collected from different reliable sources. Financial data (assets, operating revenues, operating income, net income, liabilities, equity, average number of employees, foundation date) were retrieved from the Serbian Agency for Business Registers. These data refer to the year 2014. The data on the location and the distance from three aforementioned focal points were generated from Google Maps. The data on customer satisfaction were retrieved from the *booking.com* online service for hotel bookings and rankings, where the scores from 1 to 10 assigned by hotel customers were used as an input. Social media reach as an important variable for this study was analyzed through the usage of Facebook. The data on number of hotel Facebook page likes and scores from 1 to 5 awarded by page visitors were collected. The data on number of available beds and rooms were retrieved from hotels official websites and Tourist organization of Belgrade. Hotel ranking, reputation and luxury were measured by number of stars retrieved from Tourist organization of Belgrade. Foundation dates were collected on hotel official websites.

3.3 Data analysis

After filtering the collected data, the lack of data on booking.com scores for several hotels was noticed. The software Orange Canvas was used to replace the missing values with the average value of the booking.com scores available for other hotels. Furthermore, Orange algorithm recognized few outliers and excluded them from database before proceeding with analysis. Due to perceived anomalies, the data on hotels Constantine The Great and Zepter were also excluded. Finally, statistical analysis of refined data was conducted through SPSS software.

4. RESULS AND DISCUSSION

4.1. Descriptive statistics

The following table displays the descriptive statistics: means and standard deviation for 37 observed hotels.

Table 2: Descriptive statistics

	Mean	Std. Deviation
Profit margin (%)	1.02711	31.693632
Average distance (km)	8.67805	3.206473
Market share (%)	2.30195	2.296098
LN(assets) (#)	19.77232	1.521281
Financial leverage (#)	8.144443	92.881617
No of Facebook likes (#)	3812.19	6449.961
Average score on Booking (#)	8.308	.8855
Net Promoter Score (%)	55.23511	28.186677
Net margin (%)	-11.57597	48.096229
Accommodation capacity (%)	2.00535	1.499629
Number of stars (#)	3.68	.626

4.2. Hypotheses testing

In order to test the hypotheses the study employed correlation analysis (Pearson moment two-tailed correlation) and multiple regression. Correlation analysis is performed as a preliminary analysis in order to assess the strength of relationships among the variables in the study. The results of correlation analysis are displayed in the following table. The correlation coefficients reflected low to medium values and therefore did not indicate a potential multicollinearity among variables.

Table 3: Correlation matrix

	Profit margin (%)	Average distance (km)	Market share (%)	LN(assets) (#)	Financial leverage (#)	No of Facebook likes (#)	Avg. scr. on booking.com (#)	Net Promoter Score (%)	Net margin (%)	Accommodation capacity (%)	Number of stars (#)
Profit margin (%)	1.000	.040	.212	-.013**	.006**	.102	.788	.367	.634	.082	.438
Average distance (km)	.040*	1.000	.008**	-.271**	-.080**	-.236**	.037*	.284	.024*	-.152**	-.151**
Market share (%)	.212	.008	1.000	.556	.023	.389	.277	.011*	.107	.338	.400
LN(assets) (#)	-.013**	-.271**	.556	1.000	-.260**	.307	.138	-.217**	.073	.410	.445
Financial leverage (#)	.006**	-.080**	.023*	-.260**	1.000	.225	.051	.014*	.201	.001**	-.194**
No of Facebook likes (#)	.102	-.236**	.389	.307	.225	1.000	.281	-.304**	.143	.300	.320
Avg.scr. on Booking (#)	.788	.037*	.277	.38	.051	.281	1.000	.204	.535	.009**	.561
Net Promoter Score (%)	.367	.284	.014*	-.217**	.014*	-.304**	.204	1.000	.501	-.116**	-.036**
Net margin (%)	.634	.024*	.107	-.073**	.201	.143	.535	.501	1.000	.149	.126
Accomm. capacity (%)	.082	-.152**	.338	.410	.001**	.300	.009**	-.116**	.149	1.000	.169
Number of stars (#)	.438	-.151**	.400	.445	-.194**	.320	.561	.036*	.126	.0169*	1.000

The correlation matrix shows the highest correlation of average score on Booking to profit margin. The results of employed t-test underlines this variable as the only statistically significant variable for profit margin. The next variable according to the value of correlation coefficient is net margin, followed by number of stars, implying that hotels with higher ranking, reputation and luxury generates higher profit margin. The analysis of correlation between independent variables shows that the most correlated variables are number of stars and average score on Booking, with the value of correlation coefficient 0.634. The correlation of LN(assets) to market share
(0.556) confirms that hotels that achieve economies of scale take greater market share.

Table 4: Regression model and ANOVA

Regression model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error			
1	Constant	-112.747	70.341		-1.603	.121
	Average distance (km)	-.729	1.128	-.074	-.646	.524
	Market share (%)	1.490	1.900	.108	.784	.440
	LN(assets) (#)	-4.739	3.094	-.227	-1.531	.138
	Financial leverage (#)	-.032	.040	-.095	-.814	.423
	No of Facebook likes (#)	-0.001	.001	-.126	-.964	.344
	Avg. scr. on booking.com (#)	22.364	5.538	.625	4.038	.000
	Net Promoter Score (%)	.074	.153	.066	.484	.632
	Net margin (%)	.163	.099	.247	1.639	.113
	Accommodation capacity (%)	2.382	2.508	.113	.950	.351
	Number of stars (#)	5.496	7.284	.109	.754	.457
Dependent Variable: Profit margin (%)						
ANOVA		Sum of Squares	df	Mean Square	F	Sig.
	Regression	26723.265	10	2672.326	7.362	.000[b]
	Residual	9438.243	26	363.009		
	Total	36161.507	36			

Dependent Variable: Profit margin (%)
Predictors (Constant), Number of stars (#), Net Promoter Score (%), Financial leverage (#), Accommodation capacity (%), Average distance (km), Market share (%), Net margin (%), No of Facebook likes (#), LN(assets) (#), Avg.scr. on booking.com (#)

Regression model is validated through F-test. Null hypothesis implies that linear regression model is not statistically significant, and alternative hypothesis implies that this model is statistically significant. The result

of F-test $F = 7{,}362$ and indicates that null hypothesis is accepted, meaning that overall linear regression model is statistically significant.

Average distance. The initial hypothesis: There is a negative relationship between average distance and profit margin. Average distance variable should influence the decision of tourist/customer to choose particular hotel according to the amount of time needed to get to the city's most important focal points (city center, central bus station and airport). Hotels with smaller average distance have higher occupancy rates, which could lead to higher profit margin. The result of t-test $t = -0{,}646$ and $Sig = 0{,}524$ indicates that this variable is not statistically significant for profit margin.

Market share. The initial hypothesis: There is a positive relationship between market share and profit margin. The assumption is that hotels with higher market share are more recognizable by the tourists, which could increase their profit margins. However, the result of t-test $t = 0{,}784$ and $Sig = 0{,}440$ indicates that market share is not statistically significant for profit margin.

LN (assets). The initial hypothesis: There is a positive relationship between hotel size and profit margin. Hotels with higher value of LN(assets) achieve economies of scale and reduce expenses, which increases their profit margins. The result of t-test $t = -1{,}531$ uz $Sig = 0{,}138$ indicates that this variable is not statistically significant for profit margin.

Financial Leverage. The initial hypothesis: There is a negative relationship between financial leverage and profit margin. It is assumed that hotels with lower financial leverage are more efficient, which could lead to higher profit margins. The result of t-test $t = -0{,}814$ and $Sig = 0{,}423$ indicates that this variable is not statistically significant for profit margin.

Social media reach. The initial hypothesis: There is a positive relationship between number of Facebook likes and profit margin. The number of likes on social networks indicates how particular hotel is popular among customers. Higher number of likes and followers increases the potential of a hotel to be chosen by tourists as a place to stay. Consequently, this could lead to higher profit margins. The result of t-test uz $Sig = 0{,}524$ shows that this variable is not statistically significant for profit margin.

Aggregate hotel ranking. The initial hypothesis: There is a positive relationship between average score on booking.com and profit margin. Higher average score shows higher popularity among tourists and higher customer satisfaction and potentially attract more hotel guests, which can consequently increase profit margins. However, the result of t-test $t = 4{,}038$ uz $Sig = 0{,}000$ indicates that this variable is statistically significant for profit margin.

Net Promoter Score: The initial hypothesis: There is a positive relationship between Net Promoting Score and profit margin. Net Promoting Score is marketing metrics that indirectly shows word-of-mouth effect achieved by certain hotel. Higher score indicates significant difference between respondents who recommend certain hotel and those who would not recommend it. This could lead to higher profit margins, but the result of t-test $t = 0{,}484$ and $Sig = 0{,}632$ shows that Net Promoting Score is not statistically significant for profit margin.

Net margin. The initial hypothesis: There is a positive relationship between net margin and profit margin. According to the result of t-test $t = 1{,}639$ and $Sig = 0{,}113$, this variable is not statistically significant for profit margin.

Accommodation capacity: The initial hypothesis: There is a positive relationship between accommodation capacity and profit margin. Hotels with high accommodation capacity could take advantages of economies of scale and consequently increase profit margin. The result of t-test $t = 0{,}950$ uz $Sig = 0{,}351$ indicates that accommodation capacity is not statistically significant for profit margin.

Category of hotel. The initial hypothesis: There is a positive relationship between category of hotel and profit margin. Number of stars reflects hotel's ranking, reputation and luxury. Hotels with high ranking should attract more tourists and consequently increase profit margin. According to the result of t-test $t = 0{,}754$ and , this variable is not statistically significant for profit margin.

5. CONCLUSIONS

This paper aimed to determine the main drivers of profit margins of the Belgrade hotel sector. As the results indicate the main profit margin driver is the previous customer satisfaction with hotel services As for the

contribution to the theory and practice of hotel management, this study has twofold implications. Firstly, the study contributes to the practice of hotel management as it empirically confirms that consumers and their opinions is the utterly factor that adds financial value to a hotel sector. Accordingly, the efforts of decision makers in hotels should be placed to the online reputation creation. As the results of statistical analysis indicate, the only variable that is statistically significant for profit margin is average score on booking.com, so it is recommended to make the effort to increase the rankings on booking.com. The average score on booking.com is composed by the following elements: cleanliness, location, staff, free wi-fi, comfort, additional facilities, and price-quality relation. Hotels should strive to set higher hygiene standards, improve wireless network performance, and to employ HR training and development programs in the field of customer relationship management. Significant attention should be paid to tracking and in-depth analysis of customers comments on websites booking.com and tripadvisor.com, and official Facebook pages. This analysis provides the information on the level of customer satisfaction and necessity of additional facilities and services provision. Timely identification of negative customer feedback enables hotels to fix their internal processes in order to prevent negative impact on their image and reputation. This is why these comments should be carefully tracked and responded to by a professional, regardless whether they have a positive or negative connotation.

Secondly, the paper has implications to other researchers in the field. Although the study did not cover all possible drivers of profit margins, it is important to path the way for further research in the area of hospitability industry. The study has some major limitations, both fundamental and technical. Fundamental limitations are linked to the set of variables used in the study. Accordingly, a recommendation for further research is to encompass a wider set of variables and statistically tested and refined indicators. Technical limitations are based on the sample size, timeframe, and the techniques used for the analysis. The sample size is rather small, and this study should be viewed as an ongoing project. This study is cross-sectional and based on the data from 2014. Further studies should apply time series and capture the evolutionary features of the hotel profitability in Belgrade. Finally, as all the other quantitative studies, this study has some technical flaws. Further studies should conceptualize on qualitative aspects of the topic covered and include a mixed-method approach in the analysis. Accordingly, the success on this intensively competitive market in digital era should not and can not be based solely on improvements of offline aspects of hotel industry. Hotels must focus their efforts on improving online appearance and digital reputation management.

REFERENCES

Aissa, S. B., & Goaied, M. (2016). Determinants of Tunisian hotel profitability: The role of managerial efficiency. Tourism Management, 52, 478-487.

Chen, C. M., & Lin, Y. C. (2012). Does better service induce higher profitability? Evidence from Taiwanese Hospitality Industry. International Journal of Hospitality Management, 31(4), 1330-1332.

Chiu, Y. H., & Huang, C. W. (2011). Evaluating the optimal occupancy rate, operational efficiency, and profitability efficiency of Taiwan's international tourist hotels. The Service Industries Journal, 31(13), 2145-2162.

Croston, F. (1995). Hotel profitability: Critical success factors. Accounting and finance for the international hospitality industry, 295-314.

Dimitrovski, D., Todorović, A., & Valjarević, A. (2012). Rural Tourism and Regional Development: Case Study of Development of Rural Tourism in the Region of Gruţa, Serbia, Procedia Environmental Sciences, 14, 288-297.

Horwath (2015). Special market report, Issue 53: Serbia, available at http://horwathhtl.com/files/2015/12/MR53_Serbia.pdf, accessed 22/04/2016

Kotas, R. (1982). The European hotel: methodology for analysis of financial operations and identification of appropriate business strategy. International Journal of Hospitality Management, 1(2), 79-84.

Lado-Sestayo, R., Otero-González, L., Vivel-Búa, M., & Martorell-Cunill, O. (2016). Impact of location on profitability in the Spanish hotel sector. Tourism Management, 52, 405-415.

Milosavljević, M., Milanović, N., & Benković, S. (2015). The effects of a systematic governmental measure on tourism development, in proceedings of X SPIN, Belgrade, November 5-6, 2016

Morey, R. C., & Dittman, D. A. (1995). Evaluating a hotel GM's performance: A case study in benchmarking. Cornell Hospitality Quarterly, 36(5), 30.

Mulec, I., & Wise, N. (2013). Indicating the competitiveness of Serbia's Vojvodina Region as an emerging tourism destination Tourism Management Perspectives, 8, 68-79.

Neirotti, P., Raguseo, E., & Paolucci, E. (2016). Are customers' reviews creating value in the hospitality industry? Exploring the moderating effects of market positioning. International Journal of Information Management.

Noone, B., & Griffin, P. (1999). Managing the long-term profit yield from market segments in a hotel environment: a case study on the implementation of customer profitability analysis. International Journal of Hospitality Management, 18(2), 111-128.

Phillips, P., Zigan, K., Silva, M. M. S., & Schegg, R. (2015). The interactive effects of online reviews on the determinants of Swiss hotel performance: A neural network analysis. Tourism Management, 50, 130-141.

RZS (2015). Statistical Yearbook of the Republic of Serbia, Chapter 16, available at: http://webrzs.stat.gov.rs/WebSite/repository/documents/00/01/88/99/16_Turizam_i_ugostiteljstvo.pdf accessed 22/04/2016

Sheldon, P. J. (1983). The impact of technology on the hotel industry. Tourism Management, 4(4), 269-278.

Šimičević, D., & Štetić, S. (2015). Changes in hotel offer of Belgrade driven by tourist demand. Turističko poslovanje, (16), 31-41.

Singh, A., & Dev, C. S. (2015). Winners and Losers during the Great Recession The Positive Impact of Marketing Expenditures. Cornell Hospitality Quarterly, 56(4), 383-396.

Škuflić, L., & Mlinarić, D. (2015). Microeconomic determinants of profitability for Croatian hotel industry. Ekonomski pregled: mjesečnik Hrvatskog društva ekonomista Zagreb, 66, 477-494.

Zeglat, D. (2008). An investigation of the relationship between service quality and profitability in the UK budget hotel sector (Doctoral dissertation, University of Surrey).

PROTECTION OF INTELLECTUAL PROPERTY RIGHTS - WHAT DO FINANCIAL REPORTS SAY?

Nikola Radovanović*[1], Veljko Dmitrović[2], Snežana Knežević[2]
[1]The Intellectual Property Office, Republic of Serbia
[2]Faculty of Organizational Sciences, University of Belgrade
*e-mail: nradovanovic@zis.gov.rs

Abstract: *Given the increasing importance of non-material assets, or intangibles, and the limitations which make their recognition difficult, traditional financial statements often fail to capture the value drivers that determine the market value of the companies. Although patents, trademarks, industrial designs and other intellectual property rights belong to the intangible assets in financial reports, the reports often do not separate these rights and, therefore, they are not adequately valued as a part of the companies' market value. We suggest that the change in the number of filed intellectual property rights application by companies should reflect the alteration of the share of intangible assets in the financial reports of the same companies. The methodology included quantitative and qualitative research method based on a survey, while the data has been statistically analyzed with the use of analysis of variance and chi-square tests. The findings suggest that the increased filing of intellectual property rights does not significantly affect reporting on intangible assets in financial reports of companies from technology-intensive industries in Serbia.*

Keywords*: intellectual property, intangible assets, intellectual capital, patents, trademarks*

1. INTRODUCTION

Financial reporting of intangible assets of companies is under increased focus in the last decades. Intangible assets are considered to be among the key factors of success for any company, both at present and in future (Álvarez Villanueva, 2011). It is generally understood that the biggest share of the modern company's market value lies in its non-material property, or intangible assets. Hulten and Hao (2008) state that intangible assets stand as one of the possible contributors to the disparity between market and book values of companies, and that market capitalization should reflect the value of intangible assets. Therefore, any decision on merger or acquisition, or on any big transaction between companies, require serious and detailed analysis of the intangible side of the companies in stake. Also, the relatively recent growth of the service sector and of information technology-related businesses, along with the dramatic increase in the number and size of international mergers and acquisitions, has made accounting for intangible assets highly significant (Lev, 2001; Saudagaran, 2001). An intangible asset is a claim to future benefits that does not have a physical (e.g., building or equipment) or financial (e.g., stock or bond) embodiment (Lev, 2001). For example, patents, brand names, and unique organizational infrastructures that generate cost savings for companies can be defined as intangibles (Kang and Gray, 2011). Currently, there are few comprehensive guidelines for corporations in either International Financial Reporting Standards (IFRS) or in U.S. GAAP on how to report IA, other than for purchased goodwill and development costs, in company financial statements. In other words, while the importance and the necessity of intangible assets in creating and maintaining corporate value have been widely accepted, traditional financial reporting frameworks unfortunately do not capture many of these value drivers (Jenkins and Upton, 2001; Upton, 2001; Lev and Zarowin, 1999). The reasons for that are "non-physical" nature of intangible assets and the uncertainties associated with their future benefits. However, it is clear that intangible assets in financial reports should include all intellectual property types which company possesses (as stipulated in the *International Accounting Standard 38 - Intangible Assets*). In this paper, we analyze how the applications for patents, trademarks and industrial designs, which are among the most commonly used intellectual property rights for achieving market competitiveness, are related to the reported intangible assets section of companies' financial reports.

A patent protects an invention which is new, involves an inventive step and is susceptible of industrial application. Patent applications have been frequently used as an innovation indicator on both micro and macro level. On the micro level, patenting is not carried out only for the reason of profiting from a patented

innovation through either its commercialization or licensing, but also for strategic reasons, one of which is the increase if negotiation power through increasing the value of intangible assets (Cohen et al., 2000). Evidence shows that patents very often play a critical role in creating competitive advantage of companies (Kollmer and Dowling, 2004; Giuri et al., 2005). Therefore, patents are considered to positively affect how owners and a stock market value the potential of companies through intangible assets (Fukugawa, 2012).

Trademark is the right that protects a mark used in the course of trade to distinguish goods and/or services of one natural or legal person from identical or similar goods and/or services of another natural or legal person. Regarding trademarks, Block et al., (2015) suggests that seeking trademark protection is of significant importance to small and medium-sized enterprises (SMEs) with orientation towards innovation, especially due to scarce resources which are usually a burden for smaller companies. Trademark registration is characterized as inexpensive and less complexed than patenting and, as such, serves as important appropriation function for SMEs which are interested in using intellectual property rights (Block et al, 2015). Furthermore, trademarks are seen as supplementary tools in negotiations for licensing and other means of product or service commercialization. They can strengthen the negotiating position of companies and they also have the ability to provide assurances on quality (Srinivasan et al., 2008; Block et al., 2014). The literature also suggests that trademarks are complementary to patents and that the two are used in conjunction with each other to offer more complete protection of IP assets (Blind et al., 2006; Thomä and Bizer, 2013). Trademarks may also play an important role in the appropriation of innovation rents by SMEs (e.g., Helmers and Rogers, 2010; Flikkema et al., 2014). The effects of trademarks on firms' market values has been analyzed by Sandner and Block (2011), who observed that trademarks have a positive effect on firm market value. Similar results are reported by Fosfuri and Giarratana (2009). Greenhalgh and Rogers (2012) studied the relationship between trademarks and market values of service and manufacturing firms and concluded that trademarks have a greater effect on the market values of the former that of the latter.

Finally, industrial designs are the third most common industrial property right, which provide their holders with the 25-year long monopoly (in most countries) for commercialization and prevention of use by third parties. Industrial designs are also considered an indicator of innovativeness, as they have to fulfill the requirement of global novelty as the most important requirement. Also, in some sectors, such as lightning, industrial designs are more frequently used as the IPR protection strategy that, for example, patents, due to their aesthetic characteristics. Therefore, industrial designs application are also considered as the driver of the value of intangible assets of companies.

Based on these findings, we suggest that increased orientation to patent, trademark and industrial design protection should lead to higher shares of intangible assets in companies' financial statements. We used indicators of patent applications, trademark applications and industrial design applications as variables in the analysis.

2. METHODOLOGY

In order to analyze the relationship between the filing of intellectual property rights and the reporting of intangible assets as the share of the value of total assets of companies, we have selected 29 companies from technology-intensive industries in Serbia. The selected companies are operating in the pharmaceutical industry, chemical industry, civil engineering, IT and telecommunications, and electrical equipment manufacturing. The value of reported intangible assets of companies within their total assets value reported has been taken from the mandatory financial reports open for public and given in the database of enterprises by the Serbian Business Registers Agency (available at *www.apr.gov.rs*).

For the purpose of the analysis, the data had to be normalized. In this regard, companies where the share of intangible assets was below 5% of the total assets value, the intangible assets level attributed to these companies was 0. Where this share was between 6 and 15%, the given mark was 1, while for the range between 16 and 25%, the mark was 2. The threshold for the maximum mark of 3 was at least 25%. Normalization of application for intellectual property rights has been done in a similar way. The companies who applied for only one patent/trademark/industrial design, received the mark of 1 for that intellectual property right. Where the number of applications was between 2 and 5, the mark was 2, while the maximum mark of 3 was given to companies where the number of applications for a particular intellectual property right was at least 6. Where there were no intellectual property rights filing, the company received 0 mark for that intellectual property right. The reason behind this normalization of scores is that the company who filed more than 5 applications of a particular IP right can be identified as an entity which has elements of strategic IPR management in its business.

In the final step, the comparison of the level of filing of intellectual property rights with the indicator of intangible assets share of companies has been carried out, in order to determine if there a significant interdependence of the variables. The comparison was performed with the statistical test by using analysis of variance (ANOVA) and by cross tabulation with the Chi-Square tests statistical method by using the SPSS software. Such tests were carried out having in mind that the analysis of variance (ANOVA) is normally used to determine whether there are any significant differences between the means of independent groups, while crosstabulation generates information about bivariate relationships.

3. RESULTS

Based on the analysis regarding filing intellectual property rights, total of 27.59% of analyzed companies filed at least two types of intellectual property rights which are still under IPR protection, while slightly higher portion of 31% companies filed none. Only 13.79% of companies have all three types of intellectual property rights filed and valid. Concerning particular intellectual property rights, trademark applications are dominant with 62.07% of companies filing trademark applications, 27.59% of analyzed companies filed patent applications, and 20.69% filed industrial design applications. Regarding intangible assets value share, only 31% of companies had the portion of intangible assets within the total assets value higher than 5%.

The statistical analysis with the application of cross tabulation with the Chi-Square tests has been applied to the intangible assets value and the filing of all three types of intellectual property rights separately in order to describe the relationship between these variables. The following three tables provide results from the analysis.

Table 1: Chi-Square Tests – Trademark applications/Portion of IA in total assets

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6,638a	6	,356
Likelihood Ratio	5,428	6	,490
Linear-by-Linear Association	3,268	1	,071
N of Valid Cases	29		

a. 10 cells (83,3%) have expected count less than 5. The minimum expected count is ,17.

Table 2: Chi-Square Tests – Industrial design applications/Portion of IA in total assets

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15,671a	6	,016
Likelihood Ratio	7,788	6	,254
Linear-by-Linear Association	3,328	1	,068
N of Valid Cases	29		

a. 10 cells (83,3%) have expected count less than 5. The minimum expected count is ,07.

Table 3: Chi-Square Tests – Patent applications/Portion of IA in total assets

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3,420a	6	,755
Likelihood Ratio	3,816	6	,702
Linear-by-Linear Association	,040	1	,841
N of Valid Cases	29		

a. 10 cells (83,3%) have expected count less than 5. The minimum expected count is ,07.

Based on the likelihood ratio values of 0.490, 0.254 and 0.702 respectivelly, the analysis revealed that no significant interdependence has been found between the applications for intellectual property rights and the portion of intangible assets reported as the share of the total assets value by companies. Therefore, we assume that the increased filing of intellectual property rights does not significantly affects the increase in the reporting on intangible assets share in financial statements of companies in technology-intensive industries in Serbia.

The same evidence could be found from the ANOVA analysis, as shown in the following table.

Table 4: ANOVA – Filing of IP rights

		Sum of Squares	df	Mean Square	F	Sig.
Trademarks	Between Groups	4,424	2	2,212	1,813	,183
	Within Groups	31,714	26	1,220		
	Total	36,138	28			
Designs	Between Groups	3,034	2	1,517	1,972	,159
	Within Groups	20,000	26	,769		
	Total	23,034	28			
Patents	Between Groups	1,589	2	,795	,622	,545
	Within Groups	33,238	26	1,278		
	Total	34,828	28			

The results of the ANOVA analysis show that there is no statistically significant difference between the group means, with the significance level standing above the usual cut-off point of 0.05. Thus we do not have enough evidence of interdependence between the variable representing filing of trademarks, patents and industrial designs, and the variable representing the portion of intangible assets in the value of total assets of companies.

4. CONCLUSION

The research has been carried out for the purpose of determining whether filing of intellectual property rights application significantly affects intangible assets value which is reported in the mandatory financial statements of companies coming from technology-intensive industries in Serbia. Not only that it has been shown that there is no significant interdependence between filing of intellectual property rights application and the reported share of intangible assets, but the analysis revealed that firms coming from technology-intensive industries generally report significantly small shares of intangible assets in their financial statements. Having in mind the nature of technology-intensive industries, both results were surprising. In addition, the analysis has shown that a trademark protection is highly sought by these companies, making this industrial property right dominant in comparison to both patents and industrial designs. Almost three times higher portion of companies from technology-intensive industries applied for trademark applications compared to patent applications.

The main limitation of this research is that, although it is a result of a creative activity with intangible assets involved, filing of patent, trademark or industrial design application do not necessarily lead to the granted intellectual property right. Therefore, non-granted intellectual property right may not provide monopolistic incentives for the company and may not be financially reported in the intangible assets part of the company's value. In addition, lack of ability or willingness to report separate intangible assets forms, such as patents or trademarks, in the financial reports, represents serious obstacle for detailed analysis of the effect of company's IPR protection orientation on the valuation of non-material assets of the company.

The findings of this study could be important to organizations from technology-intensive industries, which are active in filing intellectual property rights. The analysis of the relationship between filing particular intellectual property right and intangible assets value share can provide insight into the effect of IPR strength of companies to their market potential in terms of book value indicators. The results of this research may contribute to management of companies coming from technology-intensive industries, having in mind that these industries heavily rely on intellectual property rights for their competitiveness.

REFERENCES

Álvarez Villanueva, C. (2011). Towards a new model for evaluation of intangibles, Thesis, Strategy Documents T01/2011, *Corporate Excellence*.

Blind, K., Edler, J., Frietsch, R., and Schmoch, U. (2006). Motives to patent: empirical evidence from Germany. *Research Policy*, 35 (5), 655–672.

Block, J.H., Fisch, C.O., Hahn, A., and Sandner, P.G. (2015). Why do SMEs file trademarks? Insights from firms in innovative industries. *Research Policy*, 44, 1915–1930.

Block, J., De Vries, G., Schumann, J.H., and Sandner, P. (2014). Trademarks and venture capital valuation. *Journal of Business Venturing*, 29 (4), 525–542.

Cohen, W.M., Richard, R.N., and Walsh, J.P. (2000). Protecting Their Intellectual Assets: Appropriability Conditions and Why US Manufacturing Firms Patent (or not). Working Paper No. w7552. *National Bureau of Economic Research.*

Flikkema, M., De Man, A., and Castaldi, C. (2014). Are trademark counts a valid indicator of innovation? Results of an in-depth study of new benelux trademarks filed by SMEs. *Industry and Innovation,* 21 (4), 310–331.

Fosfuri, A., and Giarratana, M.S. (2009). Masters of war: rivals' product innovation and new advertising in mature product markets. *Management Science*, 55 (2), 181–191.

Fukugawa, N. (2012). Impacts of intangible assets on the initial public offering of biotechnology startups. *Economics Letters*, 116, 83–85.

Giuri, P., et al. (2005). Everything you always wanted to know about inventors (but never asked): evidence from the PatVal-EU survey, *LEM Working Paper* 2005/20.

Greenhalgh, C., and Rogers, M. (2012). Trademarks and performance in services and manufacturing firms: evidence of schumpeterian competition through innovation. *Aust. Econ. Rev.* 45 (1), 50–76.

Helmers, C., and Rogers, M. (2010). Innovation and the survival of new firms in the UK. *Review of Industrial. Organization*, 36 (3), 227–248.

Hulten, C. R., and Hao, X. (2008). What is a company really worth? Intangible capital and the 'market to book value' puzzle. NBER Working Paper No. 14548. *National Bureau of Economic Research.*

Jenkins, E., and Upton, W. S., Jr. (2001). Internally generated intangible assets: framing the discussion. *Australian Accounting Review*, 11(2), 4–11.

Kang, H.H., and Sidney J.G. (2011). Reporting intangible assets: Voluntary disclosure practices of top emerging market companies. *The International Journal of Accounting*, 46, 402–423.

Kollmer, H. and Dowling, M. (2004). Licensing as a commercialisation strategy for new technology-based firms. *Research Policy*, 33 (8), 1141–1151.

Lev, B. (2001). *Intangibles: Management, Measurement, and Reporting*. Washington, DC: The Bookings Institution.

Lev, B., and Zarowin, P. (1999). The boundaries of financial reporting and how to extend them. *Journal of Accounting Research (Autumn),* 252–285.

Sandner, P., and Block, J. (2011). The market value of R&D, patents, and trademarks. *Research Policy* 40 (7), 969–985.

Saudagaran, S. M. (2001). *International Accounting: A User Perspective*. Florence, KY: South-Western College Publishing.

Srinivasan, R., Lilien, G.L., and Rangaswamy, A., (2008). Survival of high tech firms: theeffects of diversity of product–market portfolios, patents, and trademarks. *Int.J. Res. Marketing* 25 (2), 119–128.

Thomä, J., and Bizer, K. (2013). To protect or not to protect? Modes of appropriability in the small enterprise sector. *Research Policy* 42 (1), 35–49.

Upton, W. S., Jr. (2001). *Business and Financial Reporting — Challenges from the New Economy*. Financial Accounting Series: FASB.

THE IMPORTANCE AND APPLICATION OF TRANSFER PRICING COMPLIANCE IN MODERN BUSINESS

PhD Maja Djurica*[1], MSc Marko Jovanović[1], PhD Miha Marič[2]
[1]Belgrade Business School, Simic and Partners LLC
[2]Faculty of organizational sciences, Kranj
*Corresponding author, e-mail: maja.djurica@bbs.edu.rs

Abstract: *In the modern business world it is very important that managers of international companies, which have businesses with cross-border intercompany transactions, understand the concept of transfer pricing. A transfer price is the price at which divisions of a company transact with each other. Transactions may include the trade of supplies or labor between departments. Transfer prices are used when individual entities of a larger multi-entity firm are treated and measured as separately run entities.In this paper the folowing issues wil be explained: the concept of transfer prices and their importance in tax regulations, both in Serbia, and intrantionally; who are the related parties from the point of accounting and other non-tax legislationas; what are the methods used for complience of the transfer prices, what are the arm`s- lenth trasaction and how the company could aviod them.The results and data given in this paper represents the problems seen through our clients` business and their transactions with related parties. Also, the most important and frequently asked questions about this topic are explained, and the practical answers were given. It was also necessary to justify why and how certain situations were measured. We also find that changes in exchange rates have differential effects on arm's-length and related-party prices; an appreciation of the Euro reduces the difference between the prices.*

Keywords*: transfer pricing, taxpayers, related entities, arm's length principle, methods for verifying transfer prices, Corporate Income Tax Law*

1. INTRODUCTION

The study on transfer pricing is based on the "arm's length principle" formulated in the OECD publication, entitled "OECD Transfer Pricing Guidelines for Multinational Enterprises and Tax Administrations 2010", originally published in 1995, and modified in July 2010. Adopting the principle of arm's length ensures the equal tax treatment of all taxpayers, regardless of whether it is a person who is considered to be related or not. Serbia is not a member of the Organization for Economic Cooperation and Development (OECD), but the Serbian legislation generally follows the OECD methodology and documentary requirements.
(*OECD Guidelines for the application of the rules on transfer pricing, 2010*, p. 25)

According to the "arm's length principle", internal (transfer) prices between related companies must be specified in the same way to do this unrelated parties in similar circumstances. OECD regulations require that the application of the "arm's length principle" mainly based on the comparison of the essential conditions of a controlled (related) transactions and uncontrolled conditions (between independent parties) transactions. According to the OECD Rules, transactions can be compared, if there is no difference in the conditions that may substantially affect the price, or if the differences can be removed by appropriate adjustments. To determine whether there are significant differences between the compared transactions and operations, the following five factors should be carefully considered:

- characteristics of goods or services
- functional analysis
- contractual terms
- market conditions
- business strategy

Controlled and uncontrolled transactions and entities are not comparable if there are significant differences in terms of the risk, which cannot make appropriate adjustments. If, after comparing these five factors, we conclude that the differences between the compared transactions or businesses substantially affect the price and that it cannot carry out any reasonable adjustments to eliminate these differences, transactions and operations, according to the OECD Code, cannot be considered comparable. However, the Regulation clearly states that it should not happen that useful information, that can be obtained from uncontrolled

transactions that are not identical controlled, are not taken into account because they do not meet the strict criteria of comparability. (Denčić Mihajlov, Trajčevski,, 2011, p. 397)

Permissible methods of establishing “arm’s-length” price in Serbia in 2013 (Article 61 of the Corporate Tax Law,” Official Gazette of RS", no. 25/2001 ... 108/2013) are:

- Comparable (uncontrolled) market price method
- Costs price plus usual earnings method (Costs plus gross margin method) - Cost-plus method
- Resale price method
- Transactional net margin method
- Profit split method

Denčić Mihajlov, and Trajčevski, (2011) explained that any other method by which it is possible to determine the price of a transaction on the “arm’s-length” principle, providing that the application of the method previously mentioned in this paragraph is not possible, or that the second method is more applicable to circumstances than the methods previously mentioned in this paragraph (p.399).

2. TRADITIONAL METHODS

Traditional methods are based on transactional analysis using direct and indirect methods (e.g., gross profit) in examining the nature of arm's length transactions between related companies. Traditional methods include method comparable (uncontrolled) prices in the market, the method of cost price plus usual earnings (cost plus gross margin method) and the resale price method.

- Comparable (uncontrolled) market price method "shall compare prices that will be charged with trade in goods and services in a controlled transaction with prices that are applied in the trade of goods and services in a comparable uncontrolled transaction under comparable conditions".

- Cost plus method "is based on the cost of supplier goods (or services) in a controlled transaction, which refers to the transfer of goods or services to the customer, a related party. These costs are then added to the appropriate margin to be achieved adequate earnings, according to the functions performed and the market conditions. What is obtained by adding the margin can be considered arm's length price of the original controlled transaction."

- Resale price method "is based on the price at which the product was purchased from a related party and resold to an unrelated party. This price ("resale price") shall be reduced by an appropriate gross margin ("resale price margin") representing the amount of which is expected to cover the reseller sales and other operating costs, and that, according to the functions performed (taking into account assets used and risks assumed), achieve adequate profits. What is left after deducting the gross margin and corrections based on other costs incurred in the acquisition of the good (e.g. costs of customs), can be regarded as the arm's length price for the initial transfer of assets between related parties." *(OECD Guidelines for the application of the rules on transfer pricing*, 2010, p.29)

2.1. Transactional profit methods

Transactional profit methods examine the profits resulting from transactions between related parties. Two basic methods are the transactional net margin method and profit split method. Profits arising from controlled transactions may be a relevant indicator of whether the transaction was affected by conditions that differ from those that would be incurred by third-party companies or other comparable terms. (Oosterhoff, 2014).

- Transactional net margin method examines the net profit compared to the appropriate base (e.g. costs, turnover, and assets) that a taxpayer realizes the controlled transaction. Transactional net margin realized by the taxpayer in a transaction with related parties is compared with the transactional net margin realized by unrelated parties predominantly engaged in similar transactions, and it is done by applying a statistical method that net margins in transactions between unrelated parties are spilt into the quartiles. The basic principle of this method is that the party is being tested its activity can achieve similar net profit (compared on the basis of the resulting analysis) as an independent party, then consequently prices of transactions between related parties had to be just as arm's length prices..

- Profit split method attempts to eliminate the effect on profits of a controlled transaction which is appeared due to created or imposed conditions by determining the distribution of the profit that an unrelated party expected to realize from engaging in a transaction or transactions. This method first identifies the profit from the controlled transactions in which they are related parties engaged,

which should be distributed between the parties ("combined profit"). The same goes when the company realized losses instead of profits. Then, this method distributes the combined profits between related parties, the economic-based basis which approximates the distribution of profits that would have been expected and agreed to an arrangement that is in accordance with the principle of arm's length.

When determining the price of transactions on the principle of "arm's length" is used the method that best suits the circumstances of the case, where it is possible to use multiple methods when necessary. The choice of method is based on analysis of the facts on which it is necessary to consider:

1. The nature of transactions which are the subject of analysis
2. Availability and reliability of data for analysis
3. Degree of comparability between transactions carried out on transfer pricing with transactions carried out with or between unrelated parties, if these transactions are used to verify the compliance of taxpayers transfer prices with prices determined by the principle of "arm's length"
4. The appropriateness of using financial data of unrelated parties to analyze the compliance of transfer prices for certain types of transactions that the taxpayer perform with related parties
5. The nature and reliability of assumptions (*OECD Guidelines for the application of the rules on transfer pricing, 2010, p. 45)*

Table 1: Reasons for rejection / acceptance the transfer price method from the company

Method	Reasons for rejection / acceptance from the company
Comparable (uncontrolled) market price method	Intern comparable price is not applicable as the most of the given companies have only transaction with a related parties in Serbia -The application of Externally comparable prices is also not possible because there are no publicly available data for this type of transactions (external comparable price in the country as well as the prices of such transactions abroad are not available)
Cost plus method	- there is not a possibility of establishing an internal comparable margins -There Are no publicly available data for determining externally comparable margins
Resale price method	- In order to achieve comparability of transactions and obtaining valid results, according to the OECD methodology and the Ordinance on transfer pricing, this method is primarily recommended for distributors
Transactional net margin method	- At this method the companies are comparing the net profit margin realized by the taxpayer in transactions with related parties, with net profit margins achieved in similar transactions with unrelated parties. Transactional net margin in Serbia resale is 0.53% and is significantly lower than the average transactional net margin in theEoropean resale industry, which is between 6:41% and 16.28%.
Profit split method	- This is a more optimal method because the activities of related parties so united in a way that makes it difficult to separate analysis of individual transactions between them.

3. TRANSFER PRICING - CORRECTION OF REVENUE AND EXPENDITURE IN TAX BALANCE

Popović (2013), explained that Transfer Pricing, respectively Corporate Income Tax Law, and the Ordinance on transfer pricing require Companies which have transactions with related parties that in the Tax Balance express the effects of the correction of expenditure and revenue and to increase the taxable tax base if needed. To calculate the required data, it is necessary to apply some of the previously explained methods for determining whether transactions between related prices are in line with market prices. When submitting the Tax Balance, companies should also submit a study / report on transfer pricing to the tax authorities. *(*p. 285)

In the business analysis, if the company determines that the price based on transactions with individual related party differs from the established market price, applying the principle of "arm's length", the company is required to incorporate in the tax base:

1) the amount of the positive difference between the revenues arising from the transaction at a price determined by applying the principle of "arm's length" and income arising from the transactions with transfer price, or
2) the amount of the positive difference between expenditures arising from the transactions with the transfer price and expenses arising from the transactions at a price determined by applying the principle of "arm's length".

In the conclusion of the Study of transfer pricing, it is first necessary to determine the proper amount of correction of transfer prices for each transaction associated with the related parties or for each type of transaction with individual related parties (Popović, 2013, *p.* 290).

Adding the precise amount of the correction, the company determines the total amount of the adjustment of transfer prices based on transactions with individual related parties. In accordance with Article 60, paragraph 8 of the Corporate Income Tax Law, the Company is entitled to decrease the total amount from the adjustment of transfer prices on the basis of individual transactions with related parties for:

1) the amount of the negative difference between the revenues arising from transactions with the individual related party at a price determined by applying the principle of "arm's length" and income arising from the transactions after the transfer price, or
2) the amount of the negative difference between the expenditures on the basis of individual transactions with the related party after the transfer price and expenses arising from these transactions at a price determined by applying the principle of "arm's length".

There is the necessity if the Company is not able to do internally compare the cost of transactions with related and unrelated parties, to make a comparison externally and to determine the quartiles, regarding the range of realized margins of other companies within the same Industry on the market. If the established range:

1) considers that the transfer price of the transaction does not differ from the price based on the principle of "arm's length" if the value of transfer prices is within that range;
2) the price according to the "arm's length" is equal to the central value of the specified range when the transfer price is outside the specified range.

After reducing the amount of correction, based on transfer pricing as the transactions with related party, referred to the paragraph 3 of this Article, the taxpayer determines the final amount of the adjustment of transfer prices on the basis of individual transactions with a related party. (*Law on Tax Procedure and Tax Administration (2014), paragraph 85)*

Example 1:

The taxpayer "X" during the tax sold its goods to related party "Y" on the transfer price of 10 million dinars. The price that would be achieved on this basis on the market (price - "arm's length") is 12,000,000 dinars. So, there is a positive difference between the price based on the "arm's length" and transfer price. So the taxpayer corrects its revenue for the amount of 2,000,000 dinars.

With the same related party the tax payer "X" had the expenses for lease of immovable property in the amount of 2,500,000 dinars. The rent which would be paid by the taxpayer on the market (rents on the "arm's length") is 3,000,000 dinars. So, on the expenditure side, the taxpayer, "X" on the transaction with the same related party, achieved a negative difference (transfer price is lower than the price of "arm's length") of the amount of 500,000 dinars.

The taxpayer "X" in the conclusion of the transfer pricing documentation makes a final correction of transfer prices to related party "Y" by the amount determined by the correction (2,000,000 dinars) reduced by the amount of the negative difference that is achieved on the expenditure side (500,000 dinars), so that the final correction of transfer prices to the taxpayer will be 1,500,000 dinars. 2. (Čubrić and Negovanović, 2013, p. 12)

Example 2:

The taxpayer "X" in the tax period for which the tax balance was generated, had the revenue by selling products to the related party "Y" on the transfer price of 15 million dinars. The price which the taxpayer "X" could get on the market (price "arm's length") is 18,000,000 dinars. Therefore, the correction by the taxpayer "X" on this basis is 3,000,000 dinars (positive difference between the price of "arm's length" and transfer price).

The taxpayer "X" is within the same tax period generated revenue by selling real estate to related party "Z" on the transfer price of 20 million dinars. The price which the taxpayer X would make on that basis on the market (price "arm's length") is 18,000,000 dinars. Thus, on the basis of this transaction, the taxpayer "X" has made a negative difference between the price of the "arm's length" principle and the transfer price in the amount of 2,000,000 dinars.

However, the taxpayer "X" in this case cannot be offset correction that is found in the first mentioned transaction on the basis of the positive difference between the price of the "arm's length" principle and the transfer price with negative difference that is generated in the second transaction with other related party. So that the amount of the final correction based on transfer prices to the taxpayer Y remains 3,000,000 dinars. (Čubrić and Negovanović, 2013, p. 15)

- In determining the correction based on the transactions with related parties, the company need to go through the following process:

- With individual related party transaction for each individual, and for each type of transaction, determines the amount of correction of transfer prices;

- Identifies the total amount of the adjustment of transfer prices with individual related persons on the basis of all transactions with this related party;

- The total amount of the adjustment of transfer prices with individual related persons reduced by the amount of negative differences arising in transactions with these related party;

- Reduction of the total amount of correction of transfer prices with individual related party may not exceed the amount of correction associated with that person;

- Finally, adds the total amount of correction of transfer prices established by each related party, as described above. The sum of total correction of the taxpayer needs to be stated in the tax balance position under number 50, and this amount increases the tax base of income tax.

4. TRANSACTIONS WITH RELATED PARTIES – INTERCOMAPNY LOANS

4.1. Types of transactions- intercompany financing

In accordance with Article 61, paragraph 3 of the Law on Corporate Income Tax Law ("Off. Gazette of RS", no. 25/2001, 80/2002, 80/2002 - Law, 43/2003, 84/2004, 18 / 2010, 101/2011, 119/2012, 47/2013 and 108/2013), which provides for purposes of determining the interest that would be based on the "arm's length" calculated on loans, or loans between related persons, the Minister of Finance may prescribe interest rates that will be considered in accordance with the principle of "arm's length", written in the Ordinance of interest rates which is considered to be in accordance with the principle of "arm's length". This Ordinance was published in "Off. Gazette of RS", no. 023/2015 of 02.03.2015. years and shall enter into force on the day following its publication, ie 03.03.2015. year. *(Law on Income Tax,2013, paragraph 66)*

The Law on Personal Income Tax (2013)
The Law on Enterprises (2011)

This regulation defines the interest rates that are considered to be in accordance with the principle of "arm's length".

For 2014 the interest rates that are considered to be in accordance with the principle of "arm's length" were:

- 13.82% for short-term loans in RSD;
- 11.12% on long-term loans in RSD.

The above rates apply to loans.
The taxpayer has the right to substitute the amount of the interest rate prescribed by the Minister of Finance, for the purposes of determining the amount of interest that would be based on the "arm's length" calculated

on a loan or credit with related parties, the application of general rules on determining the value of transactions on a "beyond arm's length "from the art. 60 and 61, 1 and 2 of the Law on Corporate Income Tax. (*The Law on Personal Income Tax, 2013, paragraph 52).*
A taxpayer who decides to exercise this right, shall general rules on determining the transaction price based on the "arm's length" from the art. 60 and 61 st. 1 and 2 of the Law on Corporate Income Tax Law is applied to all loans or loans with related parties.

If the taxpayer decides to exercise this right, the Tax Administration, for the purposes of determining the amount of interest that would be based on the "arm's length" and then calculated on loans, or loans between that taxpayer and related persons, is not related to the amounts of interest rates prescribed by the Minister of Finance .

In the our example The Company did not to use the opportunity given to the prescribed regulations on transfer pricing, and that it does not have to prove the level of market interest rate which should be applied to those loans in the current circumstances, but to apply the rates proposed by the Ministry of Finance of the Republic of Serbia. (Milićević and Malinic., 2013, p. 522)

During 2014 a subsidiary of the Company Ltd. gave-connected society ABC, Serbia, interest-free loans. Below is a table with an overview of current borrowings and accrued interest.

Table 2: An overview of current borrowings and accrued interest from the inter companies loans

AMOUNT OF LOANS	The date of returning	The Duration of loan in days	The period for calculation	Applied rate	Accrued interest
1.704.580,96	31.5.2014.	451	151	0,03046%	78.401,52
1.200.000,00	31.5.2014.	451	151	0,03046%	55.193,52
20.000,00	31.5.2014.	450	151	0,03046%	919,89
230.000,00	31.5.2014.	446	151	0,03046%	10.578,75
109.783,08	31.5.2014.	426	151	0,03046%	5.049,43
205.195,96	31.5.2014.	424	151	0,03046%	9.437,91
154.804,04	13.6.2014.	437	164	0,03046%	7.733,14
100.000,00	13.6.2014.	436	164	0,03046%	4.995,44
450.000,00	13.6.2014.	434	164	0,03046%	22.479,48
370.000,00	13.6.2014.	382	164	0,03046%	18.483,13
1.000.000,00	13.6.2014	329	164	0,03786%	62.090,40
550.000,00	13.6.2014.	326	164	0,03786%	34.149,72
2.200.000,00	13.6.2014	311	164	0,03786%	136.598,88
400.000,00	13.6.2014	267	164	0,03786%	24.836,16
1.200.000,00	13.6.2014	256	164	0,03786%	74.508,48
600.000,00	13.6.2014	224	164	0,03786%	37.254,24
120.000,00	13.6.2014	193	164	0,03786%	7.450,85
2.250.000,00	13.6.2014	192	164	0,03786%	139.703,40
50.000,00	13.6.2014	185	164	0,03786%	3.104,52
50.000,00	13.6.2014	184	164	0,03786%	3.104,52
100.000,00	13.6.2014	183	164	0,03786%	6.209,40
300.000,00	13.6.2014	182	164	0,03786%	18.627,12
350.000,00	13.6.2014	178	164	0,03786%	21.731,64
220.000,00	13.6.2014	140	140	0,03786%	11.660,88
536.289,54	13.6.2014	133	133	0,03786%	27.004,21
1.000.000,00	13.6.2014	128	128	0,03786%	48.460,80
850.000,00	13.6.2014	127	127	0,03786%	40.869,87
700.000,00	13.6.2014	123	123	0,03786%	32.597,46
300.000,00	13.6.2014	122	122	0,03786%	13.856,76

300.000,00	13.6.2014	120	120	0,03786%	13.629,60
10.000,00	13.6.2014	86	86	0,03786%	325,59
50.000,00	13.6.2014	85	85	0,03786%	1.609,05
250.000,00	26.9.2014	9	9	0,03786%	851,85
					973.507,61

In the tax balance is necessary to make a correction at the company our company which is a lender, so the tax base will increase for the amount of 973,507.61 dinars.

In the company of the borrower ABC is not possible to reduce the tax base on this basis.

5. THE EXAMPLE OF TRANSACTIONAL NET MARGIN

Transaction net margin applied in this particular case has the form:

$$Net\ margin = \frac{Net\ profit}{\text{Operating costs}} \text{ x } 100\%$$

This form of net margin is recommended for transactions concerning the provision of services. In determining transactional net margin realized by the taxpayer in a transaction from which he emerged transfer price, as a rule, are taken into account only those operational revenues and expenses that are directly or indirectly related to the transaction, and to the extent that they contributed to achieving net profit in the transaction. (OECD Guidelines for the application of the rules on transfer pricing, paragraph 2.77)

Costs and revenues that are not related to a controlled transaction should be excluded because they significantly affect the comparison with uncontrolled transaction. (Garrison, R and Noreen, E, 2012, p. 61)

Non-business items such as interest income and expense and income taxes should be excluded from the determination of net profit indicators. (OECD Guidelines for the application of the rules on transfer pricing, paragraph 2.80). From the income statement of the company ABC it can be seen that the total financial expenses (negative exchange differences and interest expense) was 6,416,231.34 RSD and are not taken into the calculation when calculating the total operating costs. Although it appears in the numerator net income, it is in fact about a business operating profit (excluding financial, and other extraordinary expenses and revenues), which is placed in relation to operating expenses. This is stated in Article 25, paragraph 3 of the transfer pricing that in determining transactional net margin realized by the taxpayer in a transaction from which it is derived transfer price, as a rule, are taken into account only those operating revenues and operating expenses that are directly or indirectly related to the transaction, and to the extent that they contributed to achieving net profit in the transaction.

Table 3: the example of TNM calculations

Transaction of the internal trade	
The revenue of the GERMAN company in RSD	213.210.414,80
Relevant Expenses	212.335.751,77
EBIT	874.663,03
TNM	**0,41%**
TNM on the company level	
Total Business Revenues	217.927.397,10
Total Business Expenditures	212.876.484,01
EBIT	5.050.913,09
TNM	**2,37%**

5.1 External comparable data

Data which the independent company engaged in the same or most similar type of activity and the company has tested a range of margins between 6:41% and 16.98%. This applies only to the functions performed by an independent company and tested the company. To obtain the proper range margin the company had used publicly available database AMADEUS issued by the company Bureau van Dijk. Data obtained from studies of transfer pricing companies from similar activities.

By searching the data AMADEUS obtained a sample of several companies and for each of the selected companies account net margin for each year, then the average is calculated for the analyzed period 2009-2013. year. Based on the average values of gross margins were calculated minimum and maximum, as well as the first and third quartile and median. Since there was only one comparable company from Serbia, the company included in the analysis the European companies.

The choice of this method is based on analysis of the facts that were analyzed and according to the Regulations on transfer pricing:

- Nature of transactions that are the subject of analysis;
- the availability and reliability of data for analysis;
- the appropriateness of the use of financial information unrelated persons for the analysis of transfer pricing compliance by certain types of transactions that the taxpayer performs with related parties;
- The nature and reliability of assumptions.

Net margin is the most appropriate indicator of the rate of profit to evaluate the financial operations of selected comparable companies. Based on the average value of the indicator of profit, calculated the minimum and maximum value of the net margin, or the first / third quartile and median. In order to eliminate the influence of temporary or accidental factors on the financial results, we used the averaged data for the period from 2011 to 2013. This approach is in line with the OECD Guidelines, which confirm that the use of data from several years accepted approach, and in accordance with Art. 26, paragraph 3 of the Rules on transfer pricing.

Table 4: The comparison of the quartiles

Minimum	**2,37%**
The first quartile	**6,41%**
Median	**8,86%**
The third quartile	**16,98%**
Maximum	**20,43%**

According to these results when they reject the extremes (minimum values between the first quartile and third quartile and maximum) conclusion is that the usual net margin of companies engaged in this activity between 6:41% and 16.98%, a median of 8.86%.

Net margin of our company achieved by the financial reports for 2014 is 2:37%.

6. CONCLUSION

Transfer pricing represents a major international tax planning opportunity and risk for many Multinational Companies. With a global increase in the volume and complexity of transactions among related parties and with countries looking to increase in tax revenue, tax authorities around the world have increased their scrutiny of transfer prices. The OECD has stated that “In a global economy where MNEs play a prominent role; governments need to ensure that the MNEs are not artificially shifting taxable profits out of their jurisdiction; the taxable income reported by MNEs should reflects the economic activity undertaken in the countries in which they operate." Today, MNEs are encountering an increase in the number of transfer pricing related tax audits and tax adjustments. This has brought transfer pricing to the forefront of attention for MNEs.

MNEs can create sustainable tax efficient structures by layering transfer pricing and tax planning with their supply chain initiatives. As MNEs expand or streamline their supply chains, they can make tax smart decisions about where to locate the value drivers and the important functions within their supply chains. For instance, if it makes sense to create a regional headquarters or centralized services such as a strategic sourcing group, MNEs should consider the tax rates that their cash flows would be subjected to in the various jurisdictions. MNEs should keep in mind that there are significant differences in the tax rates levied by countries they are operating in. As they decide on locations of important supply chain functions, they should perform their cost benefit analyses on an after tax basis.

REFERENCES

Abdallah, M.W. (2011) *International Transfer Pricing Policies*, New York: Quorum Books

Čubrić F., Negovanović M., 2013) *Studies of innovation knowledge in the field of transfer pricing,* Economic Advisor, Belgrade

Denčić Mihajlov, K., Trajčevski, M., (2011) *Transfer pricing in the theory and practice of multinational business Companies, Economics, 3,* 397–414.

Garrison, R., Noreen, E, (2012) *Managerial accounting*, McGraw Hill, New York

IAS - the international auditing standards, IFRS - International Financial Reporting Standards

Milićević V., Malinić D., (2013)Managerial Accounting, the Faculty of Economics Belgrade

Oosterhoff, D., March/April 2014 *Multinational Organizations Face Transfer Pricing Audits across the Globe, Transfer Pricing Trends,* Practices and Preceptions. International Transfer Pricing Journal, ,47-48

Popović D., (2013),*Tax Law, t*he tenth edition, University of Belgrade

OECD Guidelines for the application of the rules on transfer pricing (2010)

Agreements on avoidance of double taxation concluded by the RS with other countries (2010)

Law on Income Tax Law (2013)

The Law on Personal Income Tax (2013)

The Law on Enterprises (2011)

Law on Tax Procedure and Tax Administration (2014)

Law on Property Tax (2014)

Law on VAT, (2012)

HUMAN RESOURCE MANAGEMENT 688

E-RECRUITMENT: THE USE OF CONTEMPORARY TECHNOLOGIES FOR MANAGING TALENTS 689
Anđelković Labrović Jelena, Milosavljević Gordana

"JOHARI`S BEERGAME": THE EFFECT OF ALTERING COOPERATIVENESS IN SUPPLY CHAIN 694
Panić Biljana, Kovačević Ivana, Vujošević Mirko

HUMAN RESOURCES AS THE INITIATOR OF HIGH VALUE ENVIRONMENTAL PERFORMANCES OF LOCAL GOVERNMENTS OF THE REPUBLIC OF SERBIA 701
Nikolić Neda, Paunović Vladan, Dabetić Djordje

FORMER SOLDIERS' ATTITUDES TOWARDS ACTIVE RESERVE SERVICE 708
Nikolic Nebojsa

THE MAIN MOTIVATING FACTORS FOR SOMEONE TO TAKE UP ENTREPRENEURSHIP 713
Milinković Ivana, Kovačević Ivana, Mihailović Dobrivoje

IMPACT OF HUMAN RESOURCE MANAGEMENT ON ORGANIZATIONAL PERFORMANCE 720
Stanojević Dražena

SPIRAL DYNAMICS AS VALUE SYSTEM AND COMPETITIVE ADVANTAGE OF AN ORGANIZATION 725
Rodic Dusanka

MILLENNIALS IN THE WORKPLACE 733
Ivancevic Sonja, Ratkovic Tatjana

WHAT EVER HAPPENED TO THE CONCEPT OF HR BUSINESS PARTNERSHIP? SOME EVIDENCE ON FIRMS OPERATING IN SERBIA 737
Stefanović Ivan

WFMS AS THE FOUNDATION OF BUSINESS PROCESS IMPROVEMENT: HUMAN RESOURCE MANAGEMENT PERSPECTIVE 745
Minić Nemanja, Lukić Marija, Savić Milica

HUMAN RESOURCE MANAGEMENT

E-RECRUITMENT: THE USE OF CONTEMPORARY TECHNOLOGIES FOR MANAGING TALENTS

Jelena Anđelković Labrović*[1], Gordana Milosavljević[1]
[1]Faculty of Organizational Sciences, University of Belgrade
*Corresponding author, e-mail: jeca@fon.bg.ac.rs

Abstract: *Attracting, sourcing and acquiring the right people are main challenges of human resource management. The value and the success of an organization are often connected to hers talent management and the growth of human capital. The new developments and new technologies brought the necessities to implement change in these processes as well, in order to be compatible in this fast changing workforce market. The purpose of this paper is to present e-recruitment as a part of the talent management system of an organization and to depict the current state in recruiting business taking into consideration all the possibilities that the use of social networks are enabling.*

Keywords: *human resources, talent management, technologies, social networks, e-recruitment*

1. INTRODUCTION

The most frequently asked question of modern Human resource management is how to find, attract, recruit and retain talents. In this sense, contemporary literature and research within this field deal with the issues of managing talents very often. It is not possible to avoid mentioning the application of modern technologies through all the functioning processes of an organization, as well as their application in the area of human resources. The influence of contemporary technologies could be seen in human resources management activities and their everyday performance. In this paper, the recruitment process as a first and very important step in talent management will specifically be explained. Focus will be on the influence and change in delivering recruitment using modern technologies and social networks.

The paper will start with the general explanation of the terms human resource management and the talent management, as well as a recruiting process. Following, the influence of the contemporary technologies on recruitment process will be explained, with the special focus on the component of social media and social networks and their use in recruiting and managing talents.

2. TALENT MANAGEMENT

Generally, the term human resource management refers to the policies, practices, and systems that influence employees' behavior, attitudes, and performance. Human resource management includes staffing (recruitment and selection), compensating employees, employee relations, designing work, health and safety, equal employment opportunity, human resource planning as well as employee training and development (Noe, 2010, p. 4).

Talent has become the most critical and significant factor of competitiveness, it must be managed at least as carefully as any physical asset and it should be implemented with contemporary talent management technologies. Talent management could be defined as the ability to expertly attract, recruit, motivate, develop and retain staff; it is the process that brings together all human resource management processes, administration and technologies (Shweyer, 2004). Similarly, CIPD (2015) has described talent management as the systematic attraction, identification, development, engagement, retention and deployment of those individuals who are of particular value to an organization, either in view of their 'high potential' for the future or because they are fulfilling certain critical roles in an organization (CIPD, 2015). The effective talent management is a means of ensuring the right talent at the right time. Effective talent management increases the value of a company; alleviate the risk and encourages workforce productivity and innovation. Talent management system is essential for increasing the value of human capital in organization (Shweyer, 2004)

CIPD (2015) in its Annual Survey Report Learning and Development presented that companies consider as the main objectives in their organization's following talent management activities:

1. Talent management activities are more common in larger organizations,
2. In 50% cases all staff is included in talent management activities,
3. Focus is on developing high-potentials and future leaders,
4. High-potential in-house development activities, coaching, mentoring and buddying schemes are among the most commonly used and most popular and effective talent management activities.

In order to accomplish these talent management activities and result with useful talents in an organization it is our opinion that the special attention should be given to the recruitment process. According to the results of SHRM's Employee Recognition Report (2015) recruitment is in the top four challenges faced by HR organizations today, with the turnover, employee engagement and succession planning (SHRM, 2015).

Tong (2009) explains that in human resource management context, recruitment is a process of sourcing and acquiring the right applicants to an organization. Mostly this process includes searching for and attracting a pool of qualified applicants using all possible recruitment methods. The use of conventional recruitment methods is no longer suffices and timely to attract adequate number of qualified applicants. Many organizations have turned to adopting sophisticated recruitment strategies or combining various recruitment methods to attract them (Tong, 2009). This is where the application of contemporary technologies becomes useful trough different tools of e-recruiting.

3. THE USE OF CONTEMPORATY TECHOLOGIES FOR RECRUITMENT

Nowadays, different Web sites, Internet in general, provide employees with self-assessment tools, salary information for jobs within the company, career management advice, and training resources. Similarly, many companies in the employee recruitment business (such as monster.com) provide similar resources for job seekers and employers (Noe, 2010). As Shweyer (2004) emphasized, today effective talent management is not possible without the right technologies. Web brought the technologies that help employers in finding and managing job candidates. That is when talent management is viewed as a talent management system. Today there are more that hundred talent management systems (TMS) solutions providers (Shweyer, 2004).

Web-based technology is what shapes the talent management system. It is the combination of browsers, search engines, e-mail and database technology that allows talent management data to be gathered, analyzed and measured. Talent management data includes job requirements, source information, workforce plans, resume data, assessment data, contact information, testing results, background/reference data, job application history, performance data, interview results, etc. The goal is to create a talent record that is collecting data across the talent management life cycle, thus creating a more complete picture or profilepf the person's talents, aspiration and performance. Today, nearly every major vendor of e-recruitment solutions and talent management systems advertises a Web-based toolset that users can access easily trough standard browsers (Shweyer, 2004).

As the internet technologies have progressed the conventional recruitment methods have transformed to online recruitment (e-recruitment). This e-recruitment business thrived to become the second most popular online business besides booking airline tickets, in United States and Europe (Tong, 2009).

3.1. Social networks

A specific field in e-recruitment which became the most popular nowadays is e-recruitment using social networks, especially LinkedIn. Social networks will be explained highlighting the ones that are typically used for e-recruiting.

Social networking refers to systems that allow people to be networked (linked) with each other and be able to share resources with each other (Clara & João, 2010). In other words, social networks are virtual or online networks of people or communities. Depending on their purpose they can be classified as sites that are oriented to leisure, entertainment and companionship (such as: MySpace, Facebook, Twitter, etc.) and professional networking sites that focus on business networking (such as: LinkedIn, Ecademy, Yammer, etc.). Applications for social networking sites allow users to create profiles to share information about them and to identify friends or contacts out of other users with whom they share an interest. Networks such as Facebook, LinkedIn, MySpace and Twitter enable users to find and maintain personal and professional relationships with each other (Shelly & Frydenberg, 2011).

Chaka (2010) has introduced multi utility of social networks, from which the features that are most important for e-recruitment will be listed below (Chaka, 2010):

1. The establishment of professional and private contacts (networking)
2. Connecting with experts,
3. The disclosure of commonly shared activities (eg, conferences, vebineri, writing papers / books) and participation in them,
4. Exchange of knowledge, attitudes and opinions,
5. Profiling institutions ans strengthening their image, reputation and identity,
6. Marketing, advertising and promotion of institutional products and services (programs, courses, modules ...)
7. Overall recruitment and consideration of potential candidates, students or partners.

As the basic functionality of social networking from the perspective of individual users are the following: the ability to get to know people online and the ability to share and update personal and professional data about themselves. From the companies perspective social networks are mostly used to contact with their employees internally as well as externally with customers. They create communication channels that allow employees to cooperate with each other but also the consumers to express their opinion about product and services. All applications for social networking have similar characteristics of such as the ability to create profiles, the ability to determine other members of friends or contacts, and the ability to find friends of their friends. You can ask the person that shares some interests to be friends (the term used in personal networks such as Facebook and Twitter) or to connect (the term used in the professional networks like LinkedIn). Your collection of friends or contacts forms your social network. Creating a profile is also a common feature of most social networks, with the difference such as for example that the profile on Facebook mostly contains information about you and your interests, while at LinkedIn the information about persons education, current and previous job - work experience and recommendations of colleagues are posted. (Shelly & Frydenberg, 2011). Nowadays, these differences are not so distinguished since the LinkedIn has evolved and have lot of Facebook characteristics such as status massages, like/dislike and commenting of different kind, and Facebook has in professional sense so that every acknowledged company has a Facebook company profile.

3.2. The use of social networks for e-recruitment

According to SHRM Survey Findings - Using Social Media for Talent Acquisition – Recruitment and Screening (2016) HR professionals with the job function of employment or recruitment have given their opinion regarding the use of social media for talent acquisition. It is shown that (SHRM, 2016):

- Two-thirds of organizations (66%) have taken steps to leverage mobile recruiting—to target smartphone users, meaning that in most cases companies have optimized their career websites (39%), job postings (36%) and application processes (36%) for mobile users. Most major job search websites, such as Indeed, LinkedIn and Monster, have free applications for mobile user.
- Recruiting via social media is growing with 84% of organizations using it currently and 9% planning to use it - 81% of organizations reported that social media is their one recruiting tool among others and 5% of organizations reported that it is their primary recruiting tool.
- The top reason that organizations use social media for recruitment is in order to recruit passive job candidates (82%) – persons that are not actively looking for a new employment.
- Overall, 43% of organizations confirmed that the use of social media or online search engines to screen job candidates.
- Over 36% of organizations have disqualified a job candidate in the past year because of concerning information found on a public social media profile or trough an online search.

Buhalis (2016) provides a basis for understanding the impact of online and social media recruitment trends and issues emphasizing that the relationship is changed based on multiple direction of communication and inclusion of others. Social networks afford opportunities for the long-term engagement of past, current and future employees in the development and sustainability of the organization and its reputation. Relationships with all of the categories of employees can be facilitated through social media, recognizing that at different times each may play the role of promoter, recruiter, customer or ambassador. Websites, Facebook, Blogs and Twitter can build a social and professional community that is a continuous loop which outlasts one particular role or place in time. The role of the human resources department in facilitating this loop is crucial and an important area for consideration. It may also require new skills related to information technology, and for online media communication strategies to be included as part of human resource management activities (Buhalis, 2016).

In latest years lot of surveys have been conducted in order to explore the use of social media for recruiting and mostly in order to find out what social network are precived as not just as mostly used but as mostly effective as well. Here are some of the results:

- The companies that are using social media for recruiting have answered that they are using LinedIn, Facebook and Twitter for e/recruitment but that they find LinkedIn (73%) as most effective (SHRM, 2016).
- Recruiters' research showed that over 90% of companies use social media to recruit and most of them are using LinkedIn. About two-thirds of recruiters use Facebook, and little more than half are using Twitter to recruit. In most cases different social media is used as a support to traditional hiring channels by searching for candidates, posting jobs, and vetting applicants (Parkins, 2015).
- Alexander Mann Solutions and Social Talent (2016) conducted an online Global Recruiting Survey of about 1,000 sources and recruiters around the world in order to find out how social media was being used in the recruitment space (Ferguson, 2016). The results show that the most used hiring tools were social media in 2015 as it is shown in figure 1.

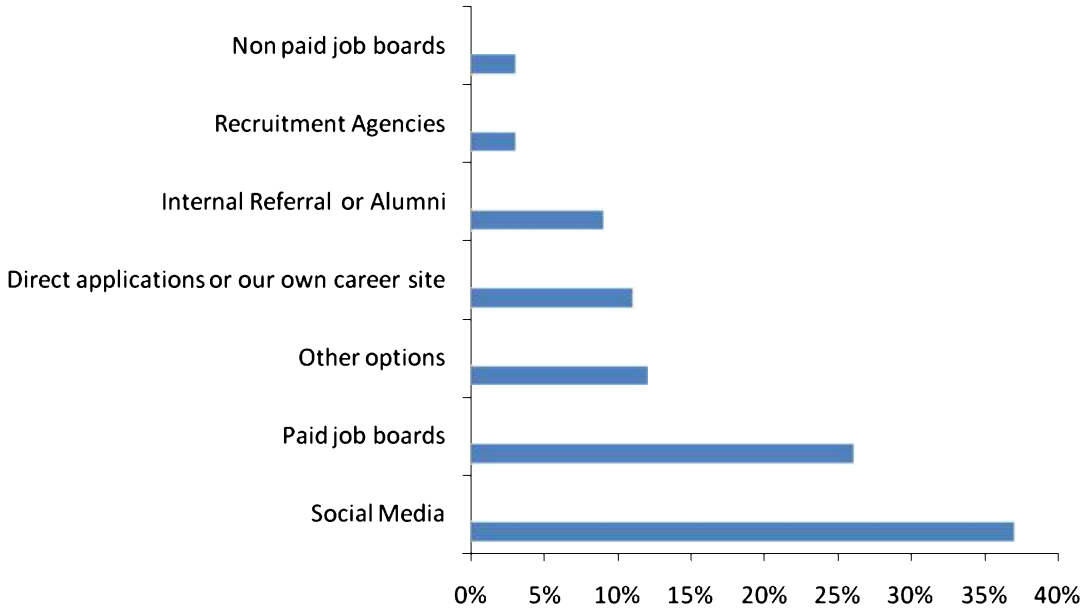


Figure 1: Where are successful hires ultimately found (Social Talent & Alexander Mann Solutions, 2016)?

As it was presented the platform becoming widely used for recruitment purposes is Web 2.0 and Social Networking Sites. Since these networks are mostly use for e-recruitment they will be presented with more details about their users in order to emphases the opportunities and the potential that they offer for finding talent in global market (Tabel 1).

Table 1: Social network characteristics: LinkedIn, Facebook and Twitter

Facebook (Facebook, 2015)	**LinkedIn** (LinkedIn, 2015)	**Twitter** (Twitter, 2015):
• 1.04 billion daily active users on average • 934 million mobile daily active users on average • 1.59 billion monthly active users • 1.44 billion mobile monthly active users • Approximately 83.6% of our daily active users are outside the US and Canada	• LinkedIn operates the world's largest professional network on the Internet with more than 400 million members in over 200 countries and territories. • Professionals are signing up to join LinkedIn at a rate of more than two new members per second. • There are more than 40 million students and recent college graduates on LinkedIn. They are LinkedIn's fastest-growing demographic.	• Twitter has around 320 million monthly active users. • 80% active users are mobile. • 3900 employees around the world, outh of what 40% are employees in technical role. • Professionals are signing up to join LinkedIn at a rate of more than two new members per second.

4. CONCLUSION

At the moment not all HR professionals are using social media for recruitment, although the presented results from a different Surveys conducted in last year has shown that are. Upon the results of SHRM (2016) Survey Findings on Using Social Media for Talent Acquisition it is recommended that HR professionals should use all options that would increase the online presence of their organizations as well as to incorporate the use of contemporary technologies into their talent acquisition strategies in order to broaden the pool of talents that they search for.

The use of social media for recruitment purposes are just beginning to be understood. It is clear that the use of social media for recruiting brought change in human resources with all of its possibilities and challenges. Human resource managers will mostly feel the consequences and they will have to be ready and willing to respond to the issues raised by these emerging practices (Buhalis, 2016). The question remains about the situation in Serbia? In our opinion, these social media tools are used in Serbia as in all other countries, since these are borderless and global trends that need to be followed in order to maintain the company's concurrency on today's market.

REFERENCES

Buhalis, A. L. (2016). Online and social media recruitment. International Journal of , 28 (2), 327 - 345.

Chaka, C. (2010). E-Learning 2.0: Web 2.0, the Semantic Web and the Power of Collective Intelligence. In H. H. Yang, & S. C.-Y. Yuen, Handbook of Research on Practices and Outcomes in E-Learning: Issues and Trends, 38-60. New York: Information Science Reference.

CIPD. (2015). Annual Survey Report Learning and Development. Retrieved april 15, 2016, from https://www.cipd.co.uk/binaries/learning-development_2015.pdf

Clara, P. C., & João, B. B. (2010). From Web to Web 2.0 and E-Learning 2.0. In H. Y. Harrison, & C.-Y. Y. Steve, Handbook of Research on Practices and Outcomes in E-Learning: Issues and Trends (pp. 19-38). New York: Information Science Reference.

Facebook. (2015, December 31). Facebook. Retrieved April 22, 2016, from Facebook newsroom: http://newsroom.fb.com/company-info/

Ferguson, H. (2016, April 12). Friend Me, Follow Me, Recruit Me: The Rise of Social Media in Talent Acquisition. Retrieved April 23, 2016, from Recruiter: https://www.recruiter.com/i/friend-me-follow-me-recruit-me-the-rise-of-social-media-in-talent-acquisition/

LinkedIn. (2015, December). LinkedIn newsroom. Retrieved April 22, 2016, from https://press.linkedin.com/about-linkedin

Noe, R. A. (2010). Employee Training and Development ((International Edition) 5th ed.). New York: McGraw Hill.

Parkins, A. (2015, January 13). The Evolution of Social Media Recruiting. Retrieved April 22, 2016, from Recruiter: https://www.recruiter.com/i/the-evolution-of-social-media-recruiting/

Shelly, G. B., & Frydenberg, M. (2011). Web 2.0: Consepts and Applications. (K. McMahon, Ed.) Boston: Course Technology, Cengage Learning.

SHRM. (2015). 2015 Employee Recognition Report. Retrieved April 22, 2016, from http://go.globoforce.com/rs/862-JIQ-698/images/Globoforce_SHRM_2015.pdf

SHRM. (2016, January 6). Using Social Media for Talent Acquisition – Recruitment and Screening. Retrieved April 22, 2016, from https://www.shrm.org/research/surveyfindings/pages/social-media-recruiting-screening-2015.aspx#sthash.vRvpnWJD.dpuf

Shweyer, A. (2004). Talent management systems: best practices in technology solutions for recruitment, retention and workplace planning. WILEY.

Social Talent & Alexander Mann Solutions. (2016). 2016 Global Recruiting Survey. Retrieved April 22, 2016, from http://185.38.105.30/docs/default-source/default-document-library/global-recruiting-survey-2016.pdf?sfvrsn=2

Tong, D. Y. (2009). A study of e-recruitment technology adoption in Malaysia. Industrial Management & Data Systems , 109 (2), 281-300.

Twitter. (2015, December 31). Twitter. Retrieved April 22, 2016, from https://about.twitter.com/company

"JOHARI`S BEERGAME": THE EFFECT OF ALTERING COOPERATIVENESS IN SUPPLY CHAIN

Biljana Panić*, Ivana Kovačević, Mirko Vujošević
Faculty of Organizational Sciences, University in Belgrade
*Corresponding author, e-mail: panic.biljana@fon.bg.ac.rs

Abstract: *There are a lot of causes of bullwhip effect in supply chains and one of them is lack of cooperability as a personality trait. In this paper, the experiment conducted on students simulating beergame will be presented. The results of the experiment showed that the cooperativeness of participants in supply chain could be, at least partially, susceptible to situational conditions due to the fact that it is possible to change them. That conclusion is based on results showing differential effects of permitting and forbidding cooperativeness in supply chain during the beergame simulation. It was found that allowing cooperativeness during the beergame simulation, among cooperative participants leads to more self disclosure and feedback sensitivity which are similar but less pronounced within noncooperative participants in the same situation. On the other hand, lack of opportunity to cooperate in beergame situation leads to the restriction from self exposure and feedback sensitivity among inherently less cooperative group and less feedback sensitivity among participants with tendency to cooperate but with lack of opportunity to do that.*

Keywords*: supply chain, beergame, cooperability, Johari Window*

1. INTRODUCTION

Lack of information and coordination in the supply chains can cause the bullwhip effect, which implies a distortion of information within the supply chain because different stages in the supply chain have different demand forecasts, so that demand increasingly varies from retailer to manufacturer. Bullwhip effect was first identified by Forrester (1958). Later, the causes of the bullwhip effect were defined as "players' systematic irrational behavior" or as a "misperception of feedback" (Sterman, 1989, Goodwin 1994). Croson et al. (2004) have classified the causes of the bullwhip effect as operational and behavioral. Detailed review of those causes is given in paperworks of Panić et al. (2014) and Panić (2015). Behavioral causes are: coordination risk, distrust, cognitive limitations, underweight the supply line, and personality characteristic. Personality characteristic which causes bullwhip effect are risk taking, ambiguity, self-efficiency, locus of control and cooperability.

Majority of researches proved that collaboration improves performance in the supply chain (Anthony, 2000; Quinn, 2000; Mentzer, Roggin, and Golicic, 2000 according to Poirier, 2002; Chopra and Meindl, 2001; Lapide, Derome, and Radjou, 2002; Barratt, 2004; Nix et al., 2004; Vereecke, Muylle, 2006; Mangan, Lalwani, and Butcher, 2008; Deloitte, 2008; Van de Vijver, 2009; Luo, Jiang, and Hu, 2010; Hudnurkar, Jakhar, and Rathod, 2014). As different authors differently define collaboration within this context, we specify collaboration as cooperative strategy of supply chain partners. Nyaga, Whipple, and Lynch (2010) in their endeavors to find factors that promote collaboration, emphasized trust, dependence, long term relationship, information and resource sharing. In one study (Panić, 2015) it is found that the more cooperative participants in supply chain achieve cost reduction. Also, it was shown that it was possible to organize supply chain consisting of more cooperative participants. In this study we try to prove that it is possible to change cooperability of the participants in the supply chain. For that purpose we use Johari Window model.

2. THE JOHARI WINDOW MODEL

The Johari Window model is a tool for illustrating and improving self-awareness, and mutual understanding between individuals within a group but it can also be used to assess and improve a group's relationship with other groups. The model was invented by psychologists Joseph Luft and Harry Ingham in 1955, while researching group dynamics at the University of California Los Angeles (Johari). Autors called their model 'Johari' after combining their first names, Joe and Harry. Johari Window model is used for understanding and training self-awareness, personal development, behaviour, interpersonal relationships, group dynamics and inter-group development, empathy, cooperation, improving communications, team development and similar 'soft' skills. The Johari Window actually represents feelings, experience, views, attitudes, skills, intentions, motivation, etc - within or about a person - in relation to their group or to represent the same information for a group in relation to other groups.

The Johari Window consists of four perspectives, regions, areas or quadrants (Figure 1) (Johari). Each quadrant represents the information about the person, in terms of whether the information is known or unknown by the person, and whether the information is known or unknown by others in the group. Standard representation of the Johari Window model shows each quadrant the same size. The Johari Window quadrants can be changed - in new groups the open space for each team member is small because shared awareness is relatively small (Figure 1a). As the team member becomes better known the size of the team member's open free area quadrant increases (Figure 1b).

Figure 1: The Johari Window

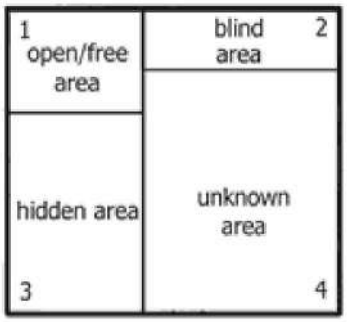


Figure 1.a: The Johari Window of a member of a new team or a person who is new to an existing team

Figure 1.b: The Johari Window of an established member of a team

The Johari window four regions are (Johari; Jalom, 2002):

- what is known by the person about him/herself and is also known by others - open area, open self, free area, free self, or 'the arena'
- what is unknown by the person about him/herself but which others know - blind area, blind self, or 'blindspot'
- what the person knows about him/herself that others do not know - hidden area, hidden self, avoided area, avoided self or 'facade'
- what is unknown by the person about him/herself and is also unknown by others - unknown area or unknown self

2.1. Johari quadrant 1 - 'open/free self/area' or 'public area', or 'arena'

Johari region 1 is also known as the 'area of free activity'. This is the information about the person - behaviour, attitude, feelings, emotion, knowledge, experience, skills, views, etc - known by the person ('the self') and known by the group ('others') (Johari; Jalom, 2002).

The aim in any group should always be to develop the 'open area' for every person, because when we work in this area with others we are at our most effective and productive, and the group is at its most productive too. This is the space of good communications and cooperation.

New team member starts with small open area because relatively little knowledge about the new team member is shared. The size of the open area can be expanded horizontally into the blind space, by seeking and actively listening to feedback from other group members - 'feedback solicitation'. Other group members can help a team member expand their open area by sensitively offering feedback. The size of the open area can also be expanded vertically into the hidden area by the person's disclosure of information, feelings, etc about him/herself to the group and group members. Group members can help a person expand their open area into the hidden area by asking the person about him/herself. Managers and team leaders can facilitate feedback and disclosure among group members or in directly giving feedback to individuals about their own blind areas. Leaders also have a responsibility to promote a culture and expectation for open, honest, positive, constructive communications, and the sharing of knowledge.

2.2. Johari quadrant 2 - 'blind self/area' or 'blindspot'

Johari region 2 is what is known about a person by others in the group, but is unknown by the person him/herself. By seeking or soliciting feedback from others, the aim should be to reduce this area and thereby to increase the self-awareness. This blind area could also be referred to as ignorance about oneself, issues in which one is deluded or issues that others are deliberately withholding from a person (Johari; Jalom, 2002).

Group members and managers can take some responsibility for helping an individual to reduce their blind area - in turn increasing the open area - by giving sensitive feedback and encouraging disclosure. Managers should promote a climate of non-judgemental feedback. The extent to which an individual seeks feedback, and the issues on which feedback is sought, must always be at the individual's own discretion.

2.3. Johari quadrant 3 - 'hidden/avoided self/area' or 'facade'

Johari region 3 is what is known to ourselves but kept hidden from others, and therefore unknown. This self represents anything that a person knows about him/herself, but which is not revealed for whatever reason. The hidden area could include fears, hidden agendas, manipulative intentions... It's natural for very personal information and feelings to remain hidden, but a lot of hidden information is related with work and so is better positioned in the open area. The aim should be to disclose and expose relevant information. By telling others how we feel and other information about ourselves we enable better understanding and cooperation. The extent to which an individual discloses personal feelings and information must be at the individual's own discretion (Johari; Jalom, 2002).

2.4. Johari quadrant - 'unknown self/area' or 'area of unknown activity'

Johari region 4 contains information unknown to the person and to others in the group. Large unknown areas would be expected in younger people, and people who lack experience or self-belief. Examples of unknown factors are as follows, and the first example is particularly relevant and common, especially in typical organizations and teams: an ability that is under-estimated or un-tried through lack of opportunity, encouragement, confidence or training; a natural ability or aptitude that a person doesn't realise they possess; a fear or aversion that a person does not know they have; an unknown illness; repressed or subconscious feelings; conditioned behaviour or attitudes from childhood (Johari; Jalom, 2002).

This information can be uncovered through self-discovery or observation by others. Counselling can also uncover unknown issues, but this would be known to the person. Whether unknown discovered knowledge moves into the hidden, blind or open area depends on who discovers it and what they do with the knowledge. The unknown area could also include repressed or subconscious feelings rooted in formative events and traumatic past experiences, which can stay unknown for a lifetime. In a work or organizational context the Johari Window should not be used to address issues of a clinical nature.

A team which understands itself - that is, each person having a strong mutual understanding with the team - is far more effective than a team which does not understand each other- that is, whose members have large hidden, blind, and/or unknown areas. Team members and leaders should always try to increase open areas and to reduce blind, hidden and unknown areas.

3. BEERGAME

Beer game was created as a part of the research of industrial dynamics in early sixties, by Sloan School of Management in Massachusetts Institute of Technology, to simulate performance of supply chain with one participant in each phase (Sterman, 1992).

Game is built up on the table representing beer manufacturing and distribution. Teams are formed to play game with the objective to minimize the expenses of whole supply chain. The winner is the team that finishes the game with minimal costs. Teams are divided into four sections: Retailer, Wholesaler, Distributor and Factory. Retailer comes to the wholesaler to buy beer. Wholesaler strives to satisfy the retailer`s demands from his supplies. Every unsatisfied order remains for subsequent period of time as backlog. Retailer asks from Wholesaler who orders from distributor, who refers to Manufacturer. Two time units (two iteration of simulation) are required for the product to pass from one participant to the other. Inventory holding costs are 0,50$ per case weekly, and backlog costs are 1$ per case weekly. Game starts from the state of equilibrium, which means that every participant has 12 cases of beer on stock, and initial demand is 4 crates in every phase. In first few weeks, participants learns about mechanisms of fill in the purchase order, creating backlogs and so on, and during that period of time demand is constant – 4 cases weekly. In first three weeks, participants can order only 4 cases per week, which is logical due to the fact that the demand is also 4 cases. At the beginning of the fourth week, participant can obtain unlimited amount of supplies, though it is pointed out that the demand of buyer could vary. One of his tasks is to anticipate the demand and to purchase accordingly. The total duration of the game is 50 weeks of simulation, but the desired effects are evident much earlier. Every participant has correct local information (about his inventory, backlogs, amount of supplies placed from his direct supplier each week and the amount of supplies he provided to other participant), but he has no insight into global information. Furthermore, communication between participants is not allowed.

Two groups (UN, CN) played according to the traditional beer game rule that each participant possesses only local information. Two other groups (UI, CI) were allowed to exchange whatever information they want. Game duration was 23 simulated weeks.

4. JOHARI`S BEERGAME: THE EXPERIMENTAL PROCEDURE

We simulated functioning of supply chain by playing partly modified beer game (Sterman, 1992). Participants in supply chain were 21 students of 3th year of Faculty of Organizational Sciences, voluntarily apply to take part in experiment. Firstly, they filled Social Value Orientation (SVO) questionnaire (Murphy et al., 2011; Murphy and Ackermann, 2012) and they were classified into cooperative or uncooperative subsample. Then, both groups were randomly divided into two subgroups, subjected to two different situational conditions. Consequently, we got four subsamples consisted from two different categories of participants, according to their individual proclivity toward cooperation, submitted to two different game rules, considering the interactional (communicational) circumstances. Those groups were:

- Uncooperative with information exchange not allowed (UN) – 4 participants
- Cooperative with information exchange not allowed (CN) – 5 participants
- Uncooperative with information exchange allowed (UI) – 7 participants
- Cooperative with information exchange allowed (CI) – 5 five participants

Each group represented one team who simulate one supply chain according to the established rules. Due to the fact that sample were students, game was renamed into a water supply game.

Due to the fact that the positions in Johari`s windows are different according to the level of mutual awareneess and familiarity developed during their common activities, there is an idea that it might indicate the behavioral change. So, we tested participants, before and after the experience of game simulation, by Johari`s methodology to see if there were any difference between their position.

In order to verify the hypothesis of possiblity to influence on behavioral change of participants in supply chainDa bi se ispitala hipoteza da je moguće uticati na promenu ponašanja učesnika u lancu snabdevanja u cilju povećanja kooperativnosti studenti su popunjavali Johari Window upitnik pre i posle simulacije.

4.1. Johari`s Beergame: Results of Experiment

There were an idea that the participants would be more ready to open toward each other and to receive feedback information, after the beergame simulation. It should be expressed through enlargement of public (open) self on behalf of blind and hidden self. Nevertheless, results indicate that different groups have different results. Each participant could gain total score between 24 and 120 on questionnaire, from 12 till 60 for self opening, as well as for readiness to accept feedback. Means for self enclosure and feedback sensitivity are given in Table 1.

Table 1. Results of Johari questionnaires before and after the beergame simulation

		CI			CN			UI			UN		
		M	**SD**	**N**	**M**	**SD**	**N**	**M**	**SD**	**N**	**M**	**SD**	**N**
oppenes	pretest	48.71	3.9	7	46.00	6.48	4	42.20	7.86	5	45.50	7.85	4
	retest	49.14	2.67	7	48.50	4.8	4	46.20	7.3	5	44.25	8.4	4
feedback	pretest	51.00	1.16	7	49.75	2.5	4	48.00	6.96	5	53.25	2.63	4
	retest	52.57	2.76	7	47.50	4.36	4	50.20	4.82	5	48.00	8.29	4
total	pretest	99.71	4.68	7	95.75	5.06	4	90.20	13.55	5	98.75	9.74	4
	retest	101.00	5.94	7	94.50	6.66	4	96.40	11.33	5	92.25	16.21	4

Comparative analysis of pretest and posttest effects is also given in Figure 2, 3. and 4.

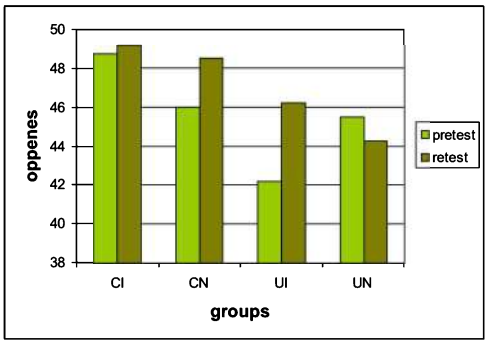


Figure 2: Enclosure before and after the simulation

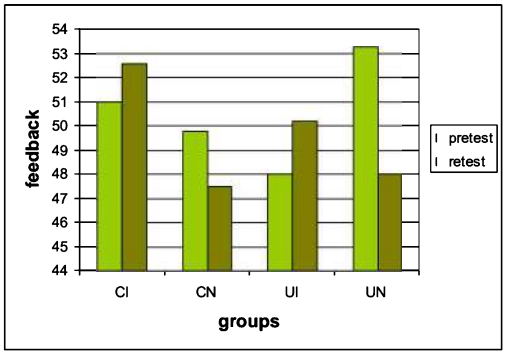


Figure 3: Feedback before and after the simulation

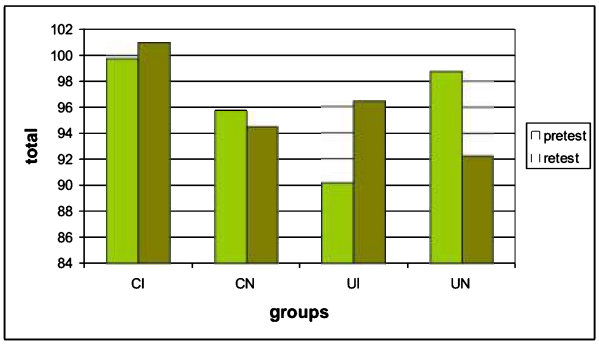


Figure 4: Total results before and after the simulation

Both cooperative groups (that were allowed to share information) (CI and UI), had expected results. That considered higher scores on self enclosure and feedback sensitivity after the simulation. CI group had heightened scores from 48.71 up to 49.14, while feedback sensitivity was increased from 51 to 52.57. UI group had higher self exposure, from 42.2 to 46.2, and more feedback sensitivity 46.2 instead of 42.2 before information sharing during the beergame simulation. Noncooperative group with no information sharing opportunity (UN) showed even reduced self disclosure tendencies (from 45.5. to 44.25), as well as the lack of readiness to receive feedback (from 53.25 to 48). Cooperative group with restriction of information sharing (CN) showed higher self enclosure, from 46, before to 48.5 after the simulation, but there were a lack of feedback sensitivity, that was 49.5 before and 47.5 after the experiment. Additionally, in this group sum of the results for self enclosure and feedback sensitivity after the game were lesser than before the game.

5. CONCLUSION

Significance of cooperativity for successful coordination in supply chain is well known fact. In the previous study of Panić (2015) less costs were found for more cooperative participants in supply chain and it was shown that it is possible to organize supply chain consisting of more cooperative participants. In this study we played beergame once again and we proved that it is possible to change cooperability of the participants in the supply chain. For that purpose Johari Window model were applied. This model gave us theoretical framework and methodological tool for indicating the level of openness and feedback sensitiveness of participants. Although we expected the overall amplification of the cooperative tendencies after the beergame simulation, i.e. after they familiarize with each other and spend some time together, results showed that there were different patterns of behavior among groups. It turned out that the results were dependent on conditions in which the game was played. Groups that were given the opportunity to share information enlarged their public self which is typical for members of well established teams. They also became more cooperative, compared to groups that had no chance to share information which is resulted in even more reduction of public self. There were possibilities that the circumstances in which information were hidden provoke distrust between participants with consequently reducing their willingness to cooperate.

As we could see from figures given in text, differences were rather small and no statistically significant, probably due to the short period of game duration. It might be assumed that the difference would increase and the results might gain on its reliability if only the simulation were last longer.

REFERENCES

Anthony, T. 2000. “Supply chain collaboration: success in the new internet economy.” Accessed January 2014. http://openstorage.gunadarma.ac.id/idkf/idkf-wireless/aplikasi/e-commerce/anthony.pdf.

Barratt, M. 2004. “Understanding the meaning of collaboration in the supply chain.” *SupplyChain Management: An International Journal* 9(1): 30-42.

Chopra, S, Meindl, P. 2001. *Supply Chain Management: Strategy, Planning, and operation*, Prentice Hall: Upper Saddle River, New Jersey.

Deloitte 2008. “Supplier/retailer relationships: A growing need for collaboration on both sides.” Accessed March 2011. http://www.deloitte.com/view/en_NL/nl/industries/consumerbusiness/3ab35915531fb110VgnVCM100000ba42f00aRCRD.htm

Forrester, J. (1958, July - August). Industrial dynamics, a major breakthrough for decision makers. Harvard Business Review, 36, 37 -66.

Goodwin, J., Franklin, S. (1994). The beer distribution game: using simulation to teach systems thinking, Journal of Management Development, 13(8), 7-15.
Hudnurkar, M., Jakhar, S., and Rathod, U. 2014. "Factors affecting collaboration in supply chain: A literature Review." *Procedia - Social and Behavioral Science*s 133: 189–202.
Jalom, I. (2002). Čari psihoterapije, Psihopolis institute, Novi Sad.
Johari window. Retrieved from: http://www.businessballs.com/johariwindowmodel.htm
Lapide, L., Derome, J. and Radjou, N. 2002. *Analysts' panel discussion, Supply Chain World North America : Extending Collaboration to End-to-End Synchronization*. 2002. in: Ayers, J.B. 2006. Handbook of Supply Chain Management. 2nd ed. Taylor &Francis Group, Boca Raton, USA.
Luo, X., Jiang, Y., and Hu, Q. 2010. Supply Chain Coordination with Shelf-Space and Retail Price Dependent Demand and Heterogeneous Retailers, DOI 10.1002/nav.20430
Mangan, J., Lalwani, C. and Butcher, T. 2008. *Global Logistics and Supply Chain Management*. John Wiley & Sons, Ltd: Chichester, West Sussex, Great Britain.
Mentzer, J.T., Roggin, J.H., and Golicic, S.L. 2000. "Collaboration: The Enablers, Impediments, and Benefits." *Supply Chain Management Review*. 4 (4): 52-58.
Murphy, R.O., Ackermann, K.A. and Handgraaf, M.J.J. (2011). Measuring Social Value Orientation. Judgment and Decision Making, 6(8), 771-781, Retrieved from http://vlab.ethz.ch/svo/SVO_paper.pdf
Murphy, R.O. and Ackermann, K.A. (2012). A review of social preferences measurement methods. Retrieved from http://vlab.ethz.ch/svo/SVO_paper.pdf
Nix, N., Zachari, Z., Lusch, R., Bridges, W., and Thomas, A. 2004. "Keys to Effective Supply Chain Collaboration." A Special Report from the Collaborative Practices Research Program, The M.J.Neeley School of Business, Texas Christian University, Fort Worth.
Nyaga, G.N., Whipple, J.M., and Lynch, D.F. 2010. "Examining supply chain relationships: Do buyer and supplier perspectives on collaborative relationships differ?" *Journal of Operations Management.* 28(2): 101–114.
Panić, B., Vujošević, M., Makajić-Nikolić, D. (2014). An Overview of Causes for Bullwhip Effect and Modes of Decreasing their Effect, XIV International Symposium 2014 SYMORG, 1249-1256.
Panić, B. (2015). "Uticaj kooperativnosti na performanse u lancima snabdevanja", phd thesis, Univerzitet u Beogradu, Fakultet organizacionih nauka, Beograd.
Poirier, C. 2002. *The Supply Chain Manager's Problem-Solver: Maximizing the Value of Collaboration and Technology*. St. Lucie Pres, A CRC Press Company: Boca Raton London New York Washington, D.C.
Quinn, F. 2000. "Collaboration: More than Just Technology." *The Aspect Project* , Accenture Publication, New York.
Sterman, J. (1989). Modelling managerial behaviour: Misperceptions of feedback in a dynamic decision making experiment, Management Science, 35(3), 321 -339.
Sterman, J. (1992). Teaching Takes Off, Flight Simulators for Management Education "The Beer Game", Retreived from: http://web.mit.edu/jsterman/www/SDG/beergame.html
Van de Vijver, M. 2009. "Collaboration In Buyer-Supplier Relationships." PhD diss., Tilburg University, Accessed January 2013. http://arno.uvt.nl/show.cgi?fid=90480
Vereecke, A., and Muylle, S. 2006. "Performance improvement through supply chain collaboration in Europe." *International Journal of Operations & Production Management*, *26*(11): 1176-1198.

HUMAN RESOURCES AS THE INITIATOR OF HIGH VALUE ENVIRONMENTAL PERFORMANCES OF LOCAL GOVERNMENTS OF THE REPUBLIC OF SERBIA

Neda Nikolić[1], Vladan Paunović[1], Djordje Dabetić[2]
[1]Faculty of Technical Sciences Ĉaĉak, University of Kragujevac, Serbia
[2]Belgrade Business School, University of Belgrade, Serbia
Corresponding author, e-mail: neda.nikolic@ftn.kg.ac.rs

Abstract: *Human resources represent a significant potential for environmental improvement. Local governments of the Republic of Serbia face environmental problems and the problems of the potential and professional development of existing human resources. Studies in this field indicate that the organizational structure, ie.theimprovement of human resource management and environmental protection largely depends on the size of the local government. The discussed current HR architecture in local governments in the Republic of Serbia points to the necessity of a new strategic approach to environmental protection with human resources as a significant element of maximizing organizational performances in the field of environmental protection.*

Keywords: *human resources, environment, local government*

1. INTRODUCTION

Improving the quality of the environment in terms of local government of the Republic of Serbia is a permanent imperative and implies a strategic change and the necessity of its modeling in order to create an efficient, modern, professional, environmentally-oriented local government. No development-oriented organization can be imagined without quality human resources and their continuous improvement. "Performers of the overall activities of the organization, the people in charge, must be competent individuals with relevant working resources necessary to the organization or its individual businesses. The level of competence of individuals increases with the development of their abilities, skills and experience (Mihailović &Ristić, 2011)."Maximizing organizational and environmental performances involves directing human resources and is achieved by managing human resources.

"Human Resource Management in essence represents a new concept of relations between an organization and its employees and of managing their work and development. Its focus is no longer just employment jobs and labor relations, but also a whole series of activities created in the field of economy, organization and management using information obtained by the organizational sciences, psychology, sociology, communication science, technology, informatics... Human resource management is a subsystem of functioning of the organization, which includes the selection and implementation of goals and policies through planning, organization, management and control of activities related to human resources toward achieving the goals of the organization (Mihailović ,*Human Resource Management,* in press)."The impact of human resource management on organizational and environmental performances is important, but the mechanisms of influence are not sufficiently clear. This suggests additional research effort in the field of environmental protection to propose an operational model of HRM activities with the possibility of its successful implementation in local governmentsof the Republic of Serbia.

Strategic planning of human resource management involves the planning of organizational personnel, their knowledge and skills, training in the field of environmental protection in order to conduct human resources of the organization through a network of social relations, and transfer it into a common interest in protecting the environment and into improving the performances of local government. Strategic management is a broader concept than the strategy itself. This is the process of implementation of the strategic plan by aligning theorganizational opportunities with changes in the environment. The process of

strategic management is closely linked with human resources. On the basis of strategic choices, the necessary human resources are defined,the capabilities and actions of which will define the implementation of the strategy and, ultimately, the outcome itself. The importance of human resources strategy for the European Union is clearly seen in the fact that at the request of the French Presidency Ernst & Young conducted a survey that provides the European Union with an overview of current changes in the world of human resources, giving hints about what we might expect in the future. The results are based on replies in a questionnaire issued in September 2008, in which more than 300 executives from 26 countries were surveyed. The research for this report assessedthe contribution to the strategic processes. The results indicate that 3/4 of respondents believe that the management of human resources is associated with the strategic goals of public administration (Student Assessment in Human Resources Management, 2008).

Local governments in Serbia have no clearly defined human resources management strategy and have their compliance with environmental protection at an even lesser degree. Differences in approaches and strategic orientation thereof stem from the size of local governments. The notion that human potential of a local governmentis an integral part to successful strategy of preservingthe environment leads to the necessity of reviewing the general strategy of each local government in terms of its uniqueness and specificity. "Our instructive consideration includes the relationship between the overall organization development strategy,its human resource management subsystem (the intervening variable) and the performance achieved by the organization. This series is already known in theory and current research in this area asthe RBV model (Resource-based view), which is supported by most current and recent research projects. Many researchers (Pertusa-Ortega et al., 2010; Collins and Clark, 2003; Hayton, 2003; Kim and Gong, 2009) have tried to discover a number of specific configurations between strategy, HRM and performances, but the notion pervades that this goal is currently unattainable. The optimal position is that any data configuration of a model has its topicality and is unique at the time of conception, but also that it should be constantly changed and adapted over time. (Mihailović, *Human Resource Management*, in press)."

"Management of human resources in environmental protection, in addition to a direct impact on the improvement of the environment, has significant impact on overall performances of the organization. Studying the cause-and-effect relationships between strategy, HRM and performances (Boseliea, 2001, Combs, 2006; Huselid, 1995), it can be concluded that a HRM unit via influence of human and social capital positively affects the performances of a local government. For this reason, the process of human resource management in environmental protection of the local governments involves the maximization of human capacities with a central tendency of enlarging the capabilities of a local government by strengthening human and social capital. It is important to emphasize that the local governmentsof the Republic of Serbia are to a large extent dormant and sluggish organizations with a significant proportion of unused human resource capacity, which requires revision of human resources. "Harington (2003) brought evidence that many organizations in their functioning only use 20% of the capacity of human resources. This means that in many companies there is 80% of formal potential burdening companies with costs, making them inactive or insufficiently active in the realization of strategic objectives. The implication that we can consider current and topical is that there is significant room for improving human resources. Using a series of derived data, Huselid (1995) argued that improving human resources can positively influence organizational performances. Human Resources (HR) and Human Resource Management (HRM) have a strategic importance being a potential value and having a central position in the creation of an entity's capabilities (organizational capabilities) responsible for their competitive advantage in market competition (Ulrich and Lake, 1999, Tuan and Takahashi, 2009).(Mihailović, *Human Resource Management*, in preparation)."

Bearing in mind human resources as drivers of high environmental performance of local government in Serbia, we have designed research and determined the relationship between variables and influence factors on the organizational peculiarities of local governments in the field of environmental protection.

The subject of the research is to analyze the relationship between organizational characteristics of human resource management and protection of living and working environment in the local self-governments in

Serbia. Key factors of the subjects of investigation are characteristic organizational forms and their dependence on the size on local government.
The aim was to determine the factors and how they affect the processes in living and working environment, human resources and their development in local governments. Based on the set of objects and the research objectives and in compliance with current theoretical platform, a hypothesis was formulated:

H. - 1. Organization of human resources engaged in theoretical conducting of environmental and labor protection in local governments depends on the size of the local communities.

2. RESEARCH PROCEDURE

The research problem is related to a very current area of environmental management at the regional level and its narrower segments - local government units (JLS). Problem focus of the research is oriented towards the respect of key resources - human resources whitch are involved in the environmental management of local self-governments depending on their size.

The collection of data required for checking the hypotheses put forward in the research project, was conducted by the method of testing as the basic method of research, which is a common phenomena of this nature. In this study, such a method was applied as a most commonly used and most effective techniques - interviewing. The research process was conducted is appropriate by an specially designed instrument-questionnaire technique implemented individual interviews respondents. Attitude management of local governments on the issue of internal characteristics and factors of human resource management JLS, was realized using specially designed indoor electronic questionnaire. Questions are classified into groups and administered in the form of „Likert-type scales“, with five offered answers to every question.

The procedure of processing the obtained data was performed using standard procedures and parameters of descriptive statistics and inference. The data are classified and processed using the software package SPSS. For the establishment of the level were used of tested characteristics and their description, descriptive statistical indicators, such as measures of central tendency (mean, median, mode) and measures deviation (standard deviation, and skjunis kurtozis), and frequency response. For testing the connection between the variables, the data in the further processing of the correlation parameters are derived (c coefficient), and tested by standard method of application $\chi 2$ test and its significance DF (with specified threshold of significance, α - usually 0.01 or 0.05).

A research conducted in the Republic of Serbia in the period from March to June 2015, on a sample of the predicted **N = 145** respondents - local governments, reduced to **n = 105** respondents (number of returned questionnaires was 108; the number of respondents who responded to the questionnaire in a very appropriate way was 105; the number of invalid questionnaires was 3). 105 respondents,a number which makes 72.41% of the total number of respondents (N = 145), is sufficient enoughfor processing and drawing valid conclusions of the research process according to statistical postulates. Testing internal factors of human resource management in the units of local governments was realized by using an instrument for data collection in the form of a closed electronic questionnaire, divided by groups of questions.

3. RESEARCH RESULTS

Local governments were classified into five net indicators by numbers of inhabitants a) in municipalities with less than 20 000 inhabitants (the first indicator); b) municipalities with over 20 000 and less than 60 000 inhabitants (the second indicator); c) municipalities with morethan 60 000 and less than 100 000 inhabitants (the third indicator); g) municipalities with more than 100 000 and less than 150 000 inhabitants (the fourth indicator) and d) municipalities with more than 150 000 inhabitants (the fifth indicator). A tabular presentation of the sample is found inTable 1.

Table 1: Overview of the sample-to-population units of local government / municipality

Size of municipality		
	f	**%**
Less than 20 000 inhabitants	47	44,8
From 20 000 to 60 000 inhabitants	36	34,3
From 60 000 to 100 000 inhabitants	7	6,7
From 100 000 to 150 000 inhabitants	10	9,5
More than 150 000 inhabitants	5	4,8
Total	105	100,0

Starting from the assumption that the organizational structure of human resources and environmental protection depends on the size of the local government, by using the χ^2 test we will check the set statement (Table 2).

Table 2: Frequency of responses and the χ^2 local government size and organizational structure of local government test

		Local government size In number of inhabitants								
		Less than 20 000 inhabitants	From 20 000 to 60 000 inhabitants	From 60 000 to 100 000 inhabitants	From 100 000 to 150 000 inhabitants	More than 150 000 inhabitants	Σ Φ	χ^2	df	p
Whether a service for the development of human resources exists at the local level	fyes	3	5	0	3	3	14	15,245	4	0,004*
	fno	44	29	7	6	2	88			
Whether there is a service for planning, development and environmental protection at the local level	fyes	18	16	7	9	5	55	20,955	4	0,000*
	fno	29	19	0	1	0	49			

*significant at the level of significance 0,01 ($p < 0,01$)

The results show that the χ^2 test is statistically significant for the existing organizational structure of the local government ($p < 0.01$) in functional areas of the existence of services for the development of human resources and the services for planning, development and environmental protection. For these reasons we reject the zero hypothesis stating that there are in no way connected with the size of the local government.

Due to this claim, further analyses have been made to determine the correlation between the size of the municipality and the stated characteristics of the organization for which the χ^2 test is statistically significant, whereby the coefficient of contingency (C- coefficient) was used. In Table 3 the χ^2 values and the contingency coefficient values are isolated.

Table 3: χ^2 size contingency coefficient of local government and of the organizational structure of local government

	χ^2	df	p	c
Department of Human Resource Development	15,245	4	0,004	0,36
Department for Planning, Development and Environmental Protection	20,955	4	0,000	0,41

As it is known, the contingency coefficient "moves" ranging from 0 to 1 (the closer to 1 the coefficient value is, the higher the correlation of variables). Since the values of obtained contingency coefficients, the statistical significance of is determined, range from 0.36 to 0.41, one can conclude that the correlation they refer to is moderate.

For a better understanding it is useful to look at the following picture derived from performed analyses.

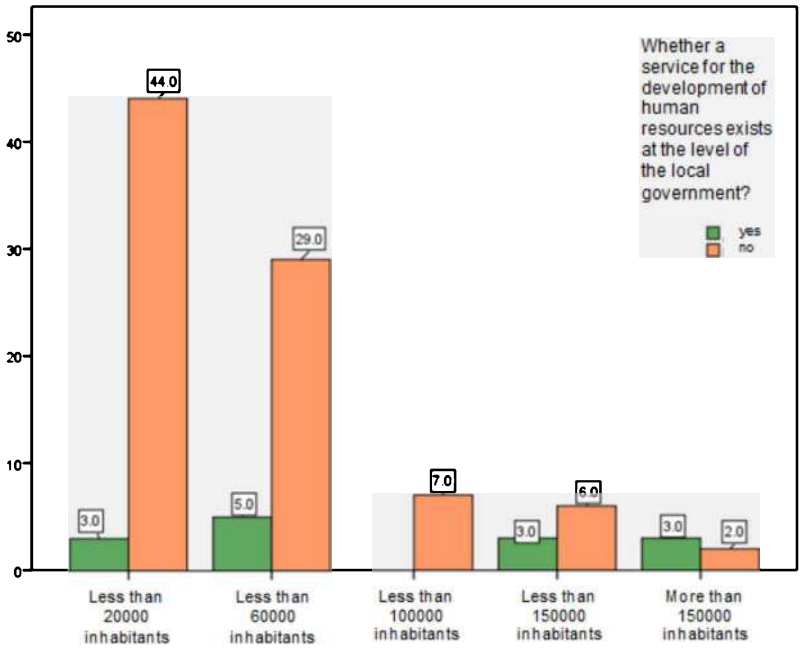


Figure 1: Correlation between the size of local government and the existence of services for human resource development

We see that the lack of services for the development of human resources is more prominent the smaller local governments are. It is necessary to bear in mind that in a total of 73% of local governments in the category of up to 60 000 inhabitants there is no human resource development service. It is interesting to note that none of the local government of 60 000 to 100 000 inhabitants there is no service for the development of human resources. Among local governments of over 150 000 inhabitants there is a higher percentage of those who have established a service for the improvement of human resources.

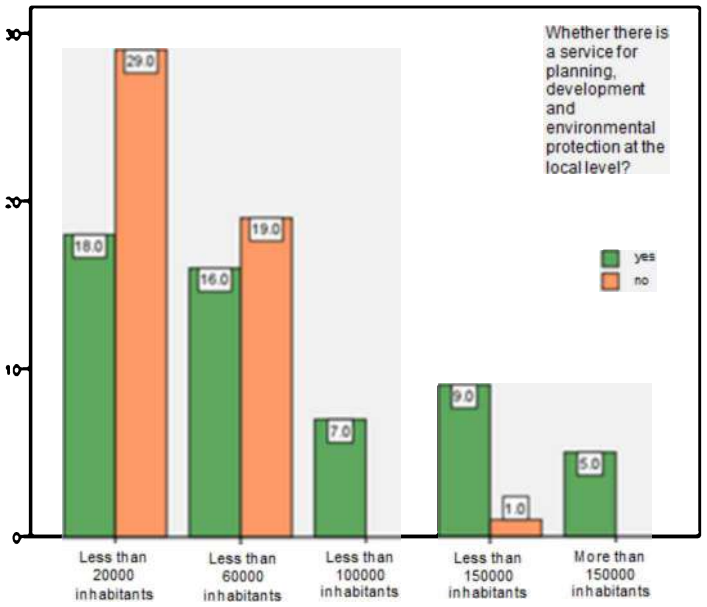


Figure 2: The correlation between the size of local government and the existence of services for planning, development and environmental protection

From the attached graphic it can be seen that in local governments with 60 000 inhabitants or less, a higher percentage of them has no established service which deals with planning, development and environmental protection. It is significant that all local governments of more than 150 000 inhabitants have a service for improving the environment in its organizational structure.

4. CONCLUSION

Human resource management in environmental protection applied with a view to mitigating or eliminating environmental externalities and to supporting the creation of sustainable development with people as the most important factor is the current strategic approach of local governments of the Republic of Serbia. Crucial support of strategic performances that are marked as successful consists of internal analysis and constant review of human resources management in the key success factors of functioning of local government, of which *the factor of environmental protection stands out in its importance*. The size of local government is one of the factors that determine the introduction of the new strategy, organizational structure modeling and business process improvement. The analysis of the results obtained during the verification and inductive set hypotheses implies that the involvement of human resources to preserve and improve the quality of life and working environment within the units of local sef governments depends on the size of local government. For this reason, we conclude that the organization of human resources engaged in the preservation and improvement of living and working environment must be adapted to the size and uniqueness of each local government.

REFERENCES

Dessler, G.(2015). Human Resource Managemnt, *12th global issue*, Mate, Zagreb.

Dess G. Gregorz, Lumpkin T. G., Eisner B. Alan, (2007). Strategijski menadžment, teorija i slučajevi, *Data Status* (treće izdanje), Beograd.

Jackson, S. E., Ones, D. S., Dilchert, S., (2012). Managing human resource for environmental sustainability, San Francisco, CA: Jossey-Bass .

Jardin, J. (2006). *Environmental Ethics – An Introduction to Environmental Philosophy* (4th ed.) Wadsworth, Thomson Learning Company.

Mankins M.C., Bird A., Root J. (2013). Making Star Teams Out of Star Players, Harvard Business Review

Mihailović, D. (2011). Leadership Competences, Faculty of Organisational Sciences, Belgrade.
Mihailović, Human Resource Management, in press.
Mihailović, D., &Ristić, S. (2011). Menadžment ljudska strana, Tehnički fakultet, NoviSad.
Nacionalna strategija zapošljavanja, „Službeni glasnik RS", broj 55/05, 71/05, 101/07, 65/08 i 16/11, Beograd.
Nacionalna strategija održivog razvoja, „Službeni glasnik Republike Srbije" (2008), broj 57, UVOD (Osnovne postavke održivog razvoja), Beograd.
Nikolić V., Sokolović D. (2007), Menadžment znanjem, ekologija znanja i razvoj ljudskih resursa u funkciji održivog razvoja, Andragoške studije br. 1.
Noe, R. A., Hollenbeck, J. R., Gerhart, B., Wright, P. M. (2006): Menadžment ljudskih potencijala, Mate, Zagreb.
Paille, Chen, Y., Boiral, O., Jin, J. (2013): The Impact of Human Resource Management on Environmental Performance: An Employee-Level Study, Springer Science + Business Media Dordrecht.
Ocenjivanje učinka u upravljanju ljudskim resursima: Analiza i operativna dimenzija; Istraživanje o javnim upravama država članica EU (2008), http://suk.gov.rs/dotAsset/10684.pdf
Petrović N., Slović D., Ćirović M. (2012), Indikatori ekoloških performansi kao smernice ka održivosti, Management, 64.
Taylor, S., Osland, J., Egri, C. P. (2012), HRM's role in sustainability: Systems, strategies, and practices [Special issue],Human Resource Management, 51(6).

FORMER SOLDIERS' ATTITUDES TOWARDS ACTIVE RESERVE SERVICE

Nebojsa Nikolic[1]
[1]Strategic Research Institute, Ministry of Defence
*nebojsa2008_g@yahoo.com

Abstract: *Personnel recruitment for armed forces is based on voluntary principle and contractual regulations of mutual obligations between the military organization and citizen who willingly decide to become a member of armed forces. This recruitment approach brings respective level of unpredictability and randomness in the process of man-powering of military units. Concept of Active Reserve is an answer to the challenge of sustainment of military units' readiness. The most desired candidates for Active Reserve positions in military units are former soldiers. That is, those people are already trained and have personal experience of how the military works. One of the most important questions is related to the motivations and propensity to serve in the military. This paper presents some results from conducted empirical research on the issues of motivations and propensity of potential candidates to apply for temporary military service through the mechanism of the Active Reserve.*

Keywords: *military, manpower, organization, motivation, reserve forces, management*

1. INTRODUCTION

Manpower structure of modern armed forces assumes two general categories: active and reserve personnel. Active personnel are those in military service who actually works for the military organization. Reserve personnel are all others who are in the evidence of the appropriate military recruitment bodies. However, they are not in military service at the moment. Military reserve personnel are called to duty only in cases of war, emergency situations or for training purposes. With suspension of conscript recruitment system and transition towards all-volunteer-force concept, military organizations have been faced with the need for additional tools for quick, efficient and effective fulfilment of empty posts in some military units. In order to manage that challenge, military organizations "invented" a specific kind of reserve soldiering status that assumes higher level of readiness, ability and will to respond to the call of duty in a short term. This mode of engagement is called the Active Reserve (in Serbia), while there are another terms in other countries.

Issues of reserve forces are actually in other countries too, particularly in the Europe. The reason for that is fact that majority of European states have made transition from conscript system and mandatory military service towards professional military forces based on voluntary system. It was happened in relatively short period of last decade of 20th century and up to now, Szvircsev (2014). To mention some of that states and date (year) when suspension of mandatory military service was put in charge: Belgium (1993), France (1996), Holland (1996), Slovenia (2002), Hungary (2004), Macedonia (2006), Bosnia and Herzegovina (2006), Romania (2007), Croatia (2007), Bulgaria (2008), Serbia (2010). Few countries which made this conversion of recruitment system much earlier than others and lead the change are the United Kingdom (1960) and the United States of America (1973). Fortunately, they have gained respective experience in dealing with various new challenges related to problems of manning an professional army and made data available, Keene (2015). Lessons learned and experience on the topic from those countries that have started earlier with professionalization and conducted new recruitment methods are very valuable and useful for many newcomers in the problem.

Reserve components itself have respectable importance, particularly when armed forces are engaged in large scale operations, for example USA armed forces in the First Gulf War, Pagonis (1992), or in a long period under high tempo of activity like Israeli Defence Forces, Catignani (2004). Reserve component is inevitable when so called "war army" structure and composition is considered Petrovic (2007); or when armed forces got the pressure from the side of engagements in international mission Sedivy (2013). Besides concept of Active Reserve seams as an efficient solution it also comes under testing towards the cost-benefit analysis Alock et all (2014). Issues about indicating the level of propensity and motivations to serve are of particular importance: Taylor et all (2015), Wiggins et all (2014), Griffit et al (1991), Nikolic (2015).

Concept of the Active Reserve could be perceived as an agility shift of the modern military organization who tend to obtain reliable mechanisms for sustaining manpower strength in a given external circumstances, limitations and available resources. Concept of agility is recognized among researchers in the military but is

also popular in the business area. Definition of the Agility Shift as it is proposed by Meyer (2015) is as follows: “The Agility Shift is the intentional development of the competence, capacity, and confidence to learn, adapt, and innovate in changing context for sustainable success.”

This definitional perception of agility fits well in the context of concept of the Active Reserve (AR). The AR concept comes from clear intention of the military organization to create additional channel for sustainment of its manpower strength level at desired level. It is adaptation of organization towards ambivalent issues of higher readiness level and limiting costs of it. Also, concept of AR is innovative one in comparison with traditional way of obtaining professional soldiers. It is innovative as well, particularly in changing context of contemporary security threats and challenges and corresponding new roles and missions for the military organizations.

2. ESTABLISHING ACTIVE RESERVE CONCEPT

Concept of Active Reserve is known in domestic defence context for almost a decade, but its full implementation in practice started in the middle of 2014, while during the 2015 started the process of selection of candidates for first contingent of one hundred future active reservists. Also, in the second part of 2014 started an empirical research on the topics of motivation and propensity of the population to serve in the status of Active Reserve. Part of that empirical research was dedicated and oriented towards the population of “former soldiers”.

Under term “former soldiers”, here we consider those people which already have experienced military organization and military life through the mechanism of mandatory military service that existed in the past before canceling conscription and introducing voluntary principle for military service. In the past, all male citizens have to serve obligatory term in the military organization and after that all of them are considered as potential candidates (reservists, passive reserve) for manning various military units in case of war. Some of those reservists are drafted and scheduled for duties in a so called “war units” that are in their essence reserve military units (“war units” or reserve military units are additional military forces that are formed in a case of war), and they are used to be called from time to time for training purposes and checks.

This kind of reserve personnel is the most desirable to be seen as applicants for the Active Reserve group. The reason is evidently based on perception about their experience in dealing with military organization: they have got basic and advanced military training through mandatory military service, and after that they gained additional experience from their temporary engagement in reserve military units where they are supposed to be called periodically for training and evidence updating. Also, they are expected to be more qualified for some jobs due to their professions and working experience in civilian life. This category will be further marked as: RSDSRU, which stands for: Reserve Soldiers Drafted and Scheduled for Reserve Units. The second group that is considered in this research presents former soldiers who just finished their mandatory military service, but have not been engaged in reserve units. This category will be further marked as: RSWSRU, which stands for: Reserve Soldiers Without Schedule in Reserve Units.

3. RESULTS OF EMPIRICAL RESEARCH

Empirical research has been conducted by researchers of Strategic Research Institute of the Ministry of Defence of the Republic of Serbia (MoD) with grateful support of other parts of MoD. Media support has been offered by Department for Public Relations, while main support in the field came from the Military Duties Department (MDD) which is responsible for tasks related to: defining measures and plans for engagement of citizens, companies, government authorities in a case of emergency and war; as well as to issues of military obligations, work and material obligations, and other tasks (for more see: http://www.mod.gov.rs/). In fact, MDD network of offices across the country were essential for successful interviewing respective number of participants in a very short time.

Questionnaire itself was created under influence of at least three factors. First, it is designed in a way to enable collection of appropriate data that could satisfy requirements that have been given at the very beginning. Second, findings and lessons learned from other similar research have been used and that contribute to efficiency of our efforts. And third, internal revisions of the draft version of the questionnaire have been used in iterative way in order to improve final document. Final form of the questionnaire contains questions grouped as follows: General data -ten questions; Information sources –four questions; Propensity to join the Active Reserve –two questions; Motivations to join the AR –fourteen questions; and Self-assessment -four questions.

Planning and realization of this empirical research was performed with full respect of the following principles: unconditional voluntarily participation and full anonymity of participants. Those two principles are fundamental because they are preconditions for frankly responds of participants. Randomness of the sample is achieved by random choice of time (period of performing empirical research) and territorial determinants (whole territory of the country).

Empirical research was realized and we have got results from 403 participants in total. In this sample there were 113 persons from RSDSRU category (Reserve Soldiers Drafted and Scheduled for Reserve Units), who were willing to fulfill the questionnaire. In conducted empirical research there were 290 persons from RSDSRU category (Reserve Soldiers Without Schedule in Reserve Units), who were willing to fulfill the questionnaire. Comparative views of findings from empirical research for both categories of former soldiers are arranged in the following tables.

Table 1: Age structure of respondents (%)

Category Age	RSDSRU (%)	RSWSRU (%)
Up to 25 years	2	9
26 to 32 years	19	38
33 to 40 years	25	34
41 and above	48	13
Not declare	6	6

Table 1 presents age structure of participants and differences between the two groups are evident. The most frequent age for the RSDSRU is 41 years and older (48%), while in the RSWSRU dominate age from 26 up to 32 years (38%). From data in Table 1, few things are evident. Age structure in category RSDSRU is not promising, because almost half of responders are too old to join the Active Reserve (there is an age limitation for joining the AR), however, their view, motivation and propensity are valuable indicator for some broader analysis because of the most valuable experience they are possessing in comparison to other category. Situation is much better with other category, RSWSRU.

Table 2: Educational level structure of respondents (%)

Category Ed.level	RSDSRU (%)	RSWSRU (%)
Elementary school	2	14
High school	66	68
Higher School (BA)	11	7
Faculty (Graduated)	21	10
Not declare		1

Table 2 gives insight into educational structure of participants. In both categories persons with high school level dominate (66% and 68%), while faculty graduates in the RSDSRU are to times better (21%) then the RSWSRU (10%). However, it is sad that in younger category of RSWSRD there are seven times more people with the elementary school than it is a case in the older one (2% against 14%). Educational indicators are in concordance with findings about employment status: the RSDSRU a group of older, but better educated population (67% employed) wins the RSWSRU a group of younger, but lower educated group (40% employed), Table 3.

Table 3: Employment status of respondents (%)

Category Age	RSDSRU (%)	RSWSRU (%)
Un-employed	31	53
Employed	67	40
Not declare	2	7

Table 4 gives answers on direct questions about propensity to serve in the Active Reserve status for two cases: service in the country, and, service in missions outside the country. Both groups showed relatively low level of interest for joining the Active Reserve military service. Average marks as estimations about level of propensity to join the Active Reserve, on the scale from 1 (absolutely not interested for joining AR) up to 5 (very interested to join), are not encouraging at all (2,83 and 3,47), particularly for the second question ("missions abroad") where results were only 2,48 for older, more educated and more employed population (RSDSRU), while results for the other group are something better but is still far from very good.

Table 4: Propensity to serve in AR

Category Mission	RSDSRU (on the scale 1-no to 5-yes)	RSWSRU (on the scale 1-no to 5- yes)
In the country	2,83	3,47
In missions abroad	2,48	3,20

Finally, empirical findings related to the possible motivational factors for joining the Active Reserve are presented in Table 5. In some sense this findings are expected particularly for the more experienced, more educated and more employed group (RSDSRU). This category of population is more realistic and objective, illusion-free, more informed and so on. The first motive is patriotism, than follows: money, getting new knowledge and earning new qualifications. This motivational constellation is not strange as it look like at the first impression. Possible explanation (at least for the author) could be as follows: this mature group is not too much interested in military service at all (Table 4 results), they realize practical benefits from potential engagement (money, knowledge, qualifications) however, primary factor for potential joining, would be patriotism. In any case, those findings are in favor of the Serbian Army as an entity closely perceived with patriotism, but also as a good employer which is able to offer good knowledge and additional qualifications, as well as to give fair money for work and engagement.

Table 5: Motivations ranks to join the AR

	MOTIVES	RSDSRU	RSWSRU
1.	Patriotism	1	1
2.	Money	2	2
3.	Getting new knowledge	3	5
4.	Earning new qualifications	4	4
5.	Care for peace	5	3
6.	Getting to know new people	6	8
7.	Family tradition	7	6
8.	Arms fan	8	9
9.	Military life fan	9	7
10.	Curiosity	10	11
11.	Oportunity to travel	11	10
12.	Adventurism	12	12
13.	Health insurance	13	13
14.	Opportunity to give orders	14	14

4. CONCLUSION

Modern armed forces are deeply dependent on its reserve personnel. This is particularly true for professional armies whose manpowering is based on the voluntary principle. Motivational issues of the population to join military service, in this case Active Reserve, have very high importance for overall process of obtaining personnel for military units with principle of voluntary recruitment.

Conducted empirical research offers results for one of the most desirable group for recruitment for military Active Reserve and those are former soldiers with more or less additional military experience. Findings on motivation to join the Active Reserve are in favour of the Serbian Army as an entity closely perceived with patriotism, but also as a good employer which is able to offer good knowledge and additional qualifications, as well as to give fair money for work and engagement. Level of propensity to join Active Reserve is better for younger population of the sample, than for the older one.

Acknowledgement: This work will be partially supported by the Ministry of Education and Science of the Republic of Serbia under Interdisciplinary Project No.III-47029 (Project title: "Cost Effective Selection of New Technologies and Concepts of Defence Through Social Reforms and Strategic Orientations of Serbia in 21st Century).

REFERENCES

Alock, S., Greenhalgh, K., Taylor, L., Murphy, P. (2014). Who Pays for Gareth? Relyung on Reservists: The UK Government's Strategic Defence and Security Review. The Journal of Finance and Management in Public Services, 14(1), Retrieved from: http://www.cipfa.org/policy-and-guidance/the-journal-of-finance-and-management-in-public-services

Catignani, S. (2004). Israeli Defence Forces Organizational Changes in an Era of Budgetary Cutbacks. *RUSI Journal,* 149(5), 72-76.

Clarke, J. (2013). Europe's Armed Forces in Civil Security. *Connections: The Quarterly Journal,* 12(2), 69-82. Retrieved from: http://dx.doi.org/10.11610/ Connections.12.2.04.

Griffith J., Perry S., Rauch J., Greenless J., Baker S., Rauch C., Toskin L., Rhoads M., Wolters C. (1991). Survey of United States Army Reserve (USAR) Troop Program Unit (TPU) Soldiers. Technical Report AD-A237 406, Westat Inc., Rockville, MD, USA.

Keene, S. (2015). The Effective Use of Reserve Personnel in the U.S. Military: Lessons from the United Kingdom Reserve Model. *Report,* Strategic Studies Institute and U.S. Army War College Press. Retrieved from: www.strategicstudiesinstitute.army.mil/ pubs/display.cfm?pubID=1245

Meyer, Pamela. (2015). The Agility Shift – Creating Agile and Effective Leaders, Teams, and Organizations. Bibliomotion, Brookline, MA USA.

Nikolic, N. (2015). Zainteresovanost za sluzbu u Aktivnoj rezervi. *Vojno Delo, 5/2015*, 315-332. (www.odbrana.mod.gov.rs/odbrana-stari/vojni_casopisi/arhiva/VD_5-2015/67-2015-5-19-Nikolic.pdf).

Nikolic, N. (2015, October). Serbian Security Perceptions: Motivations to Serve. *Information & Security: An International Journal*, 33(2), 122-137. (http://dx.doi.org/10.11610/isij.3306).

Pagonis, W. (1992). Moving Mountains: Lessons in leadership and Logistics from the Gulf War. Harvard Business School Press, Boston, Massachusetts, USA.

Petrovic, Z. (2007). Ratna vojska Srbije u uslovima potpune profesionalizacije. *Vojno Delo,* 59(4), 108-130. ISSN 0042-8426.

Sedivy, J. (2013). NATO and Reserve Forces – a Czech View. *The Officer*, 2013, Retrieved from: www.mzv.cz/nato.brussels/en/news_articles_speeches/ index_2.html

Szvircsev, T. (2014, 3-4 December). Europe's Armed Forces in Transition: From Conscription to all-volunteer forces 1975-2014. *International Workshop "10 Years after Suspending Conscription: Transition and Transformation*".

Taylor, J., Clerkin, R., Ngaruiya, K., and Knox Velez, A.L. (2015). An Exploratory Study of Public Service Motivation and the Institutional-Occupational Model of the Military. *Armed Forces & Society,* 41(1), 142-62. Retrieved from: //dx.doi.org.10.1177/0095327X13489119

Wiggins, B., Evans, S., Luchman, J., Gibson J. (2014). Motivators and Barriers to Recruiting Prior Service Members in the IRR. *Military Psychology*, 26(1), 23-32. //dx.doi.org/10.1037/mil0000026

THE MAIN MOTIVATING FACTORS FOR SOMEONE TO TAKE UP ENTREPRENEURSHIP

Ivana Milinković[1], Ivana Kovačević[1], Dobrivoje Mihailović[1]
[1]Faculty of Organizational Sciences
Corresponding author, e-mail: i.milinkovic93@gmail.com

Abstract: *Managers and entrepreneurs both play an important role in the business community. Many of them share some of the same characteristics, but some differences exist when it comes to the basic traits of each. One of the differences is in the way of their motivation which we try to explaine in this paper through Self-determination theory that include autonomous motivation and controlled motivation.*
The purpose of this paper is also to present relationship between entrepreneurship and motivation and how human motivation might influence the entrepreneurial process. Study of the entrepreneurial process and entrepreneurs motivation is important because it drives innovation and technical change, and therefore generates economic growth. The main point of discussion is motivational differences, variations across people in their perceptions of risk and opportunity which influence entrepreneurial decisions.

Keywords*: Motivation, autonomous motivation, controlled motivation, managers, entrepreneurs, motivating factors*

1. INTRODUCTION

How and why entrepreneurs formulate business ideas and choose their business ventures is a subject of continuing study. We can observe motivation ~~-as~~ the inner state that energizes activities or action and directs or channels behavior towards the goal" (Asagwara, 2000). The main question is where do entrepreneurs get so much motivation, where does it come from? What is the difference between people who always seem to have so much motivation and energy, and others who struggle with just getting the first page of a business plan written?

Newly created enterprises increase the dynamism of economies and generate employment. The SME sector in Serbia recruits 53.3 percent of total employment, 60.7 percent of total investments, realizes 77 of exportation and participates with around 61.6 percent of the GDP (Chamber of Commerce and Industry of Serbia). Since they have such a big impact on the economy, they are the object of growing research interest. Focus is on entrepreneurs who form a new company. The first step is to make a decision about forming a new company, which is based on both personal and subjective motives. Founder's motivation represents a commitment to a project or business idea, and affects the development and success of the company in the future (Sánchez, Sahuquillo, 2012).

In this paper, we suggest how human motivation might influence the entrepreneurial process. Through self-determination theory we would like to explain the differences between autonomous motivation and controlled motivation. Our assumption is that autonomous motivation is more pronounced among entrepreneurs and controlled motivation among managers. With this assumption we do not want to exclude the fact that all human actions are the result of both motivational and cognitive factors, and that also includes ability, intelligence, and skills (Locke,2000).

2. SELF-DETERMINATION THEORY (SDT) – AUTONOMOUS AND CONTROLLED MOTIVATION

As a macro theory of human motivation, self-determination theory (SDT) suggests that people are motivated by a need to grow and gain fulfillment. Their activities are directed toward personal development, life goals and aspirations, self-regulation, energy and vitality and need to gain knowledge or independence (Deci, Ryan, 2008).
The self-determination theory identifies three key psychological needs that should be satisfied to raise well-being and health. Also, according to the theory, people need to feel the following in order to achieve psychological growth, but some of these needs may be more salient than others at certain times or expressed differently based on time, experience or culture. These needs can be universally applied.

- **Competence** - Seek to control the outcome and experience Master (White, 1959).
- **Relatedness** - Universal want to interact, be connected to, and experience caring for others

(Baumeister, Leary, 1995).

- **Autonomy** - Need to feel in control of own behaviors and goals. This does not mean to be independent of others (Deci, Vansteenkiste, 2004).

The most important difference in self-determination theory is between autonomous motivation and controlled motivation. Our assumption is that the autonomous motivation is more common with entrepreneurs while controlled motivation is typical for managers.

2.1. Autonomous motivation

Autonomous motivation can be defined as a set of intrinsic motivation and some types of extrinsic motivation in which people integrated a value of an activity into their sense of self (Deci, Ryan, 2008), more specifically as the motivation to work on something because it is interesting and personally challenging. An entrepreneur is a starter, an individual whose main goal is to start a business by setting up an enterprise. He starts the business for his personal gratification, and become the leader responsible for the destiny of the venture.
Intrinsic motivation is form of autonomous motivation. Intrinsically motivated peoples work for passion, pleasure, and interest. Intrinsic motivation correlates with proactive engagement in work (Gagne, Deci, 2005) and high levels of psychological health (Baard, 2004; Deci, 2001).

An entrepreneur is a person in charge with direct financial benefits, but also assumes all risks involved in running the enterprise. One of the most frequently asked questions is ~~-w~~what motivates an entrepreneur to take all the risks and start a new business?" In the most cases, the answer is an ~~-e~~ntrepreneurial obsession". The most successful entrepreneurs are not also the most talented, but the one who have ideas, see an opportunity, and find out what customers want. They have conviction and believe in their ideas. The main reason for an entrepreneur to start a business enterprise is his individual satisfaction and opportunity to create a new environment, create something from scratch, meet new people, build a team and create a jobs.

This theoretical approach of understanding the motivation that drives entrepreneurs can be confirmed through numerous examples from practice. One of the successful entrepreneurs is Robert Mondavi, who felt ~~-r~~eborn" after starting the winery that bears his name. ~~-I~~was like a kid again, bursting with energy, ready to climb the mountain, conquer the world, go for the gold. Yes, at the unlikely age of fifty-two, the great adventure of my life had finally begun" (GCASE – Global Community for Advancing Studies on Entrepreneurship). This approach and the type of motivation is the opposite of being extrinsically motivated. Extrinsic motivation means being motivated by expected evaluation, external rewards such as money, fame, and praise, and it leads to a decrease in intrinsic motivation. Entrepreneurs do what they love, and they love what they do (GCASE).

2.2. Controlled motivation

Deci and Ryan (2008) defined controlled motivation as a function of external contingencies of reward or punishment. Regulation of action is energized by factors such as an approval motive, avoidance of shame, contingent self-esteem, and ego-involvements (Deci, Ryan, 2008). In cases when people are controlled, they might to feel pressure to think or behave in particular ways. Controlled motivation can also be defined as a desire to transfer learning that is not initiated and governed by the self (i.e. regulated by external rewards or sanctions) (Deci, Ryan, 2008).

A manager is a person who is a servant in the enterprise owned by the entrepreneur, but he or she does not bear any risk involved in the enterprise. Every month a manager gets fixed salary as the reward for the services rendered by him in the enterprise. A manager is a part of controlled work environment which diminish employees experiences of autonomy, competence, and relatedness. Externally regulated managers see workplace rules as externally imposed, what limits their passion and desire for change, and their only motivation is to obtain rewards such as praise, promotions, and financial benefits. Typically top managers instead of using motivation in the workplace to inspire people to work better, they believe in the idea that ~~-p~~ressure makes diamonds". There is also a believe that if you want exceptional performance, you align employee objectives with end-of-year bonuses for hitting certain milestones and then employees will turn up their work ethic to reach them (Tim Olson, Olson group).

Regarding points of distinctions, we can conclude that an entrepreneur differs from a manager and that different thing motivates them. A manager is someone good at execution. Typically managers follow a business plan, or strategic plan, which they may or may not have had any say in developing. The entrepreneur has an idea for a new business. Entrepreneurs are independent thinkers, brave enough to take risks and put ideas into action. All this differences influence on their motivation and goals. In this paper, we

would like to put the focus on entrepreneur motivation and entrepreneurship because newly created enterprises increase the dynamism of economy and generate employment, and that could be one of the way of reshaping the future- through entrepreneurship.

3. MOTIVATIONAL CONCEPTS THAT DRIVES ENTREPRENEURS

No two entrepreneurs are alike and there is a range of factors which could inspired them to take the leap and start a business. One of a judge for Ernst and Young's Entrepreneur of the Year (EOY) Award Program, Jack Stack, said that their inspiration and motivation is evident in their appearance and behavior - "You can see it in their eyes. You can see it in their confidence. You can see it in the way they talk" (GCASE). Entrepreneurs are creative and willing to take risks especially if they know they can influence the outcome of the event. They have great vision of commitment, vision, and passion. They are idealistic and optimistic, innovative, aggressive, and intensely focused.

Study of the entrepreneurial process and entrepreneurs' motivation is important because it drives innovation and technical change, and that leads to economic growth (Schumpeter, 1934). Entrepreneurial action is the process through which supply and demand are equilibrated (Kirzner, 1997). Also, we can observe entrepreneurship as an important process by which new knowledge is converted into products and services (Shane & Venkataraman, 2000). It has become an important vocation, and has important role in the development of human and intellectual capital (Zahra & Dess, 2001).

Motivational differences in many ways influence on entrepreneurial process. One of the things that have an effect on entrepreneurial process is variation across people in their perceptions of risk and opportunity (Shane & Venkataraman, 2000). People vary in how they view the risk of expending resources before knowing the distribution of outcomes (Palich & Bagby, 1995). At the entrepreneurial process the probability of success is low. Only those people who are willing to precede despite these odds might be more optimistic or higher in self-efficacy than people deterred by these odds.

Through the example of an entrepreneurial process and motivational concepts that are defined by Scott Shane, Edwin A. Locke and Christopher J. Collins in the paper "Entrepreneurial motivation", we will try to explain motivational concepts that drive entrepreneurs. Also, Ivan Bjelajac COO at Devana and one of the most successful Serbian entrepreneur explained on his example how he see the different motivational factors, and what drives him through his entrepreneurial career.
There is a set of human motivations that psychologists have shown to influence many aspects of human behavior. These include the motivations, nAch, and the locus of control, desire for independence, passion, and drive.

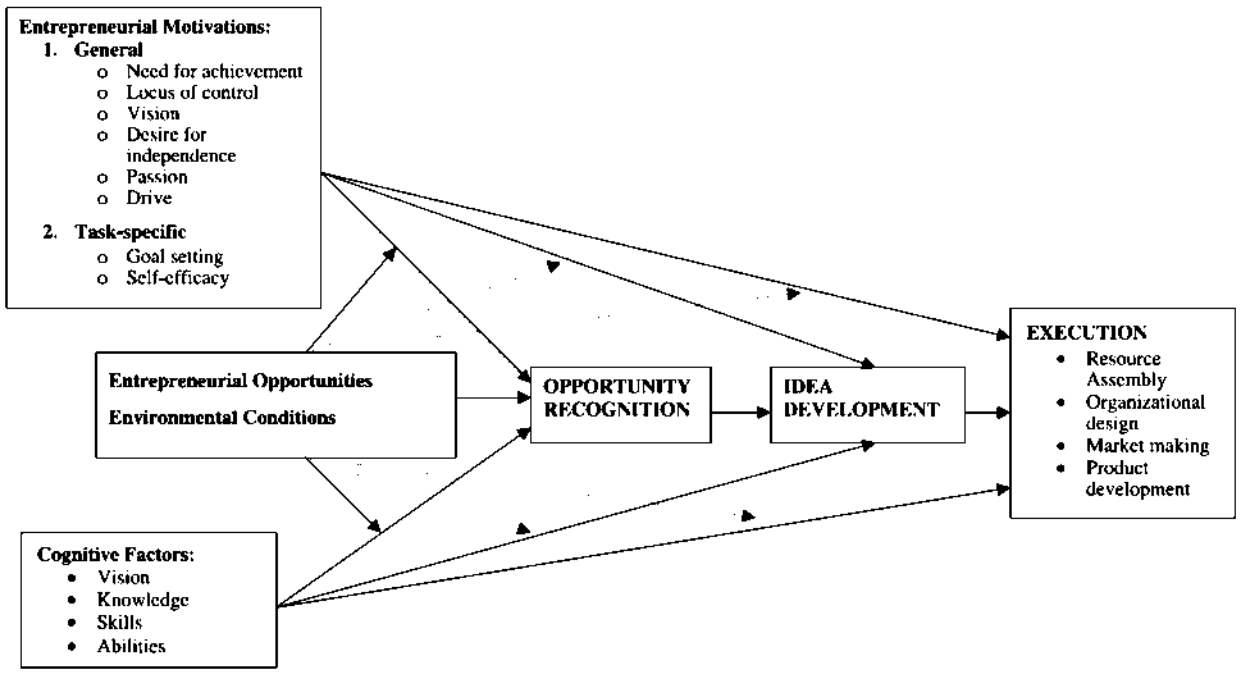


Figure 1: Model of entrepreneurial motivation and the entrepreneurship process (according to Shane, Locke & Collins, 2003).

Need for change and achievement

The need for achievement is driven by the need for a sense of control and in particular it is evidence that we can influence what happens around us. Achievement can also boost our sense of identity as our achievements help define our self-image. Individuals who are high in nAch are engage in activities or tasks that have a high degree of individual responsibility for outcomes, require individual skill and effort, have a moderate degree of risk, and include clear feedback (McClelland, 1961). Maslow (1943) effectively includes achievement as a part of self-actualization, where we seek to achieve what we are capable of achieving.

Balaji Viswanathan, Product Manager at a VC Funded Startup, from his experience, said that entrepreneurs constantly want change; they have a wish to be the bearers of the change and constantly achieve more. They are problem solvers, but also motivated to create something new. Every entrepreneur has a vision ("I want to aggregate the world's information" or "I want to put a PC on every desk") and always find a way to realize the same.

Ivan Bjelajac, COO at Devana and one of the most successful Serbian entrepreneurs, said that everyone likes to give his life some meaning, you can do it in many ways, but building stuff is a great way to do it. He thinks that all people love to see something they created being used by other people. When someone compliments your product, it feels very special.

Risk-taking

Entrepreneurship means risk, the risk of walking away from security and career path to create something new. Most business types that thrive on innovation will encourage risk takers. Individuals who have higher achievement motivation should prefer activities of intermediate risk because these types of activities will provide a challenge (Atkinson,1957). On the other hand, individuals who score high on the motive to avoid failure will avoid intermediate risks. Begley (2000) defined risk-taking propensity as the willingness to take moderate risks.

Balaji Viswanathan, Product Manager at a VC Funded Startup said that many people who like to start-up, want it for the challenge and want to handle big problems. Also, he said that successful entrepreneurs are always curious and ask - what if we implement a new way of working, and remove existing. They endeavor to understand the customer's minds, markets and competitors. They almost always include huge risk while making decisions. Balaji Viswanathan concludes that an entrepreneur in no different from a researcher who is searching for the truth.

On the other hand, Ivan has an opinion that whole life is filled with taking risks. We take risks every day, but most people are not even aware of them. Entrepreneurship can mean that you are aware of the risks and want to influence the outcome. Not influencing the outcome could be considered more dangerous. Actually, Ivan thinks that entrepreneurship is not so much about risks.

Tolerance for ambiguity

Ambiguity refers to the situation which is doubtful or uncertain. Tolerance for ambiguity can be understood as an important trait for entrepreneurs. The challenges and potential for success associated with business start-ups are unpredictable (Schere, 1982). It involves tolerance for ambiguity as the propensity to view situations without clear outcomes as attractive rather than threatening for entrepreneurs (Budner, 1982). Entrepreneurs continually meet more and more uncertainty in their everyday life, but the business owners with a high tolerance for ambiguity can normally handle new and unpredictable situations.

Many entrepreneurs do not like ambiguity. They want to influence the outcome. However embracing ambiguity can sometimes be mind opening and can lead to some amazing results (Ivan Bjelajac).

Locus of control

There are two types of individuals - ones who have an external locus of control, and others who have an internal locus of control. People with an external locus of control believe that the outcome of an extent is out of their control, and attribute their success or failure to outside influences. The others, with an internal locus of control, are the ones who base their success on the own work and completely control their lives. They also believe personal actions directly affect the outcome of an event (Rotter, 1966). That is why an internal locus of control would be likely to seek entrepreneurial roles. They desire positions in which their actions have a direct impact on results (Durand, 1975).

So, we can conclude that entrepreneurial actions affect the outcome of an event. Individuals have the opportunity to be more creative when running own business. They can experiment with a new website design, develop new marketing strategy, create something innovative, design new packaging and new advertising campaigns.

People, especially entrepreneurs, do stuff because they want autonomy, purpose, and mastery (Ivan Bjelajac).

Self-efficacy

Self-efficacy is the belief in one's ability to muster and implement the necessary personal resources, skills, and competencies to attain a certain level of achievement on a given task (Bandura, 1997). Regarding self-efficacy, or confidence as it is commonly known, we can explain why people of equal ability and knowledge can have different results and successes.
An important role in determining chances for success is self-efficacy. Individuals with high efficacy have a positive attitude towards new situations and difficult tasks see as a challenges rather then the limitations. This approach leads in intrinsic interest in activities. For entrepreneurs it is characteristic to have high efficacy, which is reflected through the continuous setting of challenging goals. Entrepreneurs always have a strong commitment to accomplish those goals.

Goal setting

Edwin Locke, in 1960's, put forward the Goal-setting theory of motivation. This theory predicts that people will channel effort toward accomplishing their goals, which will in turn affect performance (Locke & Latham, 1990). Locke and Latham (2002) found a direct linear relationship between goal difficulty, level of performance, and effort involved. This relationship will stay positive, as long as the person is committed to the goal, has the requisite ability to attain it, and doesn't have conflicting goals (Locke & Latham, 2006).
If an individual has a challenging, specific, and concrete goal, that is also measurable, he or she will setting a structure which directs actions to achieve the same.

One of the MIT professors, Edward Roberts, has also addressed this topic. He has studied MIT graduates who had gone on to start technology-related businesses. Through its research he discovered that the most successful ones did not seek ~~s~~ome intangible objective." Instead, they want to create something ~~s~~ignificant and tangible", and it was a challenge for them.

Many people are able to make a onetime success without setting a clear goal. Goals are key to understanding failure and success and repeating it (Ivan Bjelajac).

Independence

For all entrepreneurs, starting a business is the route to ~~l~~life, liberty, and the pursuit of happiness," no matter how risky. Independence makes people more capable, more prepared and a little more confident on handling issues that are a part of their lives. They are more prepared to make decisions and take actions without having to wait for support or permission.
Independence is leading motivation for entrepreneurs. That assumption is proved by Hornaday and Aboud (1973) who were interviewed 60 founders. All the founders were significantly higher than the general population on measures of independence.

Balaji Viswanathan, Product Manager at a VC Funded Startup, also conclude from his experience that independence is one of the key factors that drives entrepreneurs. Many guys who start-up a business, do that don`t wanting to be a part of a company in which they have no way to shape the destiny. They wish to create work their own time, own place, own tasks and goals.

Ivan Bjelajac, COO at Devana agrees that for many entrepreneurs, starting a business is the route to ~~l~~life, liberty, and the pursuit of happiness". Running your own business gives you a sense of freedom.

Drive

The drive is a willingness to put forth effort— both the effort of thinking and the effort involved in bringing one's ideas into reality (Shanea, Locke, Collins, 2003). When entrepreneurs pursue the opportunity, they must take action to make it real. There are the four aspects of the drive: ambition, goals, energy and stamina, and persistence (Shanea, Locke, Collins, 2003).

–Because an entrepreneur can never be sure of a return on his investment, starting up a business is like offering a gift to the world, in the hope, but never the certainty, that the gift will be reciprocated" (George Gilder). Through this sentence, technology guru George Gilder described how he see importance of drive in entrepreneurship.

Ivan also explained this from his experience –The key to success is that when you fail, you must fail quickly and inexpensively. Test, analyze, figure out why you failed, evolve, and iterate. Focus and energy are two key attributes of the drive. That is the meaning of having the drive because there is no way to do that without being self-driven."

Egoistic passion

For the most of the entrepreneurs, ego is a central motive to take up entrepreneurship. After they took the first step in starting business, they passionately start the process of building an organization and making it profitable. They are lying an effort to do what is actually in their interest.

Amar Bhide, after a ten-year period of teaching and studying entrepreneurship at Harvard Business School, concluded that –it takes an extraordinary individual to build a promising company - extraordinary regarding someone who has an almost maniacal level of ambition. Not just an ambition to make a comfortable living, to make a few million dollars, but someone who wants to leave a significant mark on the world" (GCASE).

Entrepreneurs choose to "live a few years of your life like most people won't so that you can spend the rest of your life like most people can't." Ivan said: –I do not necessarily agree with this presumption, but it is true that money is a big motivator. I always felt like ownership devoid of work is a bit parasitic, so I think that entrepreneurship is a great way to build assets you can play with later" (Ivan Bjelajac).

4. CONCLUSION

Entrepreneurs do not only produce revolutionary technology, they also change human habits and lifestyle, and become cultural phenomena. Bill Gates was a major figure and successful entrepreneur in the 1990s. In the 2000s, it was the late Steve Jobs and the Google boys, Larry Page and Sergey Brin. And now, in 2010s, we have a Facebook founder Mark Zuckerberg.

These people and more other entrepreneurs are motivated by a range of factors that are different for everyone. When we talk about motivation we should considered both personality and the environment. For example, Need achievement theory explains why high achievers (entrepreneurs) choose challenging tasks and why low achievers (managers) choose easier tasks. And each of the above-mentioned motivation theories has some valid points. But, in general, the most important issue is to recognize the small number of bio-behavioral wants as the basis of all motivation.

When we talk about entrepreneur's motivation, about –entrepreneurial obsession", we talk about intrinsic motivation. Intrinsic motivation is a term that explains one's desire to work on something that is stimulating satisfying or challenging on a personal level. On the other side, there are the people who are extrinsically motivated, driven by expected evaluation and rewards. Almost all entrepreneurs enjoy their work, have clearly set goals, and strive to create something that is tangible and significant.

Regarding motivational factors in this paper, we try to explain how an entrepreneur differs from a manager and how different things motivate them. A manager is someone good at execution. Typically managers follow a business plan, or strategic plan, which they may or may not have had any say in developing, while entrepreneurs have ideas for a new business. Entrepreneurs are independent thinkers, brave enough to take risks and put ideas into action.

Through the road map of an entrepreneurial process, our attention was to review the major motivations that prior researchers have suggested should influence the entrepreneurial process, as well as to give examples of entrepreneurs who use their experience to explain all of those motivations. Also, this paper providing specific recommendations how motivations might influence the entrepreneurial process at each of its stages and main conclusion in this paper is that motivated entrepreneurs are the most important factor to the entrepreneurial process, human motivation in all theories of the entrepreneurial process is crucial.

REFERENCES

Atkinson, J. W. (1957). Motivational determinants of risk-taking behavior. *Psychological Review, 64*(6, Pt.1), 359-372.

Baard, P. P., Deci, E. L., & Ryan, R. M. (2004). The relation of intrinsic need satisfaction to performance and well-being in two work settings. *Journal of Applied Social Psychology, 34*, 2045–2068.

Bandura, A. (1997). *Self-efficacy: the exercise of self control*. New York: Freeman

Barba-Sánchez, V., Atienza-Sahuquillo, C. (2012). Entrepreneurial behavior: Impact of motivation factors on decision to create a new venture. *Investigaciones Europeas de Dirección y Economía de la Empresa, 18*(2),132-138

Begley, P.T. (2000). Values and Leadership: Theory Development, New Research, and an Agenda for the Future, *The Alberta Journal of Educational Research 46*(3), 233-249

Budner, S. (1982). Intolerance of ambiguity as a personality variable. *Journal of Personality, 30*, 29–50.

Chamber of Commerce and Industry of Serbia. Retrieved from: http://www.pks.rs (Privredna komora Srbije)

Croitoru, A. (2012). Schumpeter, J.A., 1934 (2008). The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest and the Business Cycle, translated from the German by Redvers Opie, New Brunswick (U.S.A) and London (U.K.): Transaction Publishers.A Review of a Book 100 years old. *Journal of Comparative Reasearch in Anthropology and Sociology*, *3*(2), 137-148.

Deci, E. L. (1975). *Intrinsic motivation*. New York: Plenum.

Deci, E. L., Gagné, M. (2005). Self-determination theory and work motivation. *Journal of organizational behavior , 26*(4), 331-362.

Deci, E. L., Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry , 11*(4), 227-268.

Deci, E. L., Vansteenkiste, M. (2004). Self-determination theory and basic need satisfaction: Understanding human development in positive psychology. *Ricerche di Psichologia 27*, 17–34.

Deci, E. L., Ryan, R.M. (2008). Self-determination theory: A macrotheory of human motivation, development, and health, *Canadian Psychology/Psychologie canadienne, 49*(3), 182-185

Durand, D. E. (1975). Effects of achievement motivation and skill training on the entrepreneurial behavior of black businessmen. *Organizational Behavior and Human Performance, 14*, 76–90.

Fraser, C., & Scherer, K. R. (1982). *Advances in the social psychology of language*. Cambridge: Cambridge University Press.

GCASE – *Global Community for Advancing Studies on Entrepreneurship*. Retrieved from: http://gcase.org/

Harter, S. (1978). Effectance motivation reconsidered: Toward a developmental model. *Human Development, 1*, 661–669.

Kirzner M. (1997). Entrepreneurial discovery and the competitive market process: An Austrian approach. *Journal of Economic Literature, 35*(1), 60-85.

Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin 117*, 497–529

Locke, E. A. (2000). *The prime movers: Traits of the great wealth creators*. Amacom New York, NY.

Palich, L. E., Bagby, R. D. (1995). Using cognitive theory to explain entrepreneurial risk-taking: Challenging conventional wisdom, *Journal of Business Venturing, 10*(6), 425-438

Maslow, A. H. (1943). A theory of human motivation, *Psychological Review, 50*(4), 370-396

McClelland, D. (1961).*The Achieving Society*. Princeton: D van Nostrand.

The Olson group. Retrieved from: http://www.olsongroupltd.com

Rotter, J.B. (1996). Generalized expectancies for internal versus external control of reinforcement, *Psychological Monographs: General and Applied, 80*(1), 1-28.

Shane, S., Venkataraman, S. (2000). The Promise of Entrepreneurship as a Field of Research.*The Academy of Management Review,25*(1),217-226

Shanea, S., Lockea, E.A., Collins, S. J. (2003). Entrepreneurial motivation, *Human Resource Management Review*, *13*, 257–279

White, R. W. (1963). *Ego and reality in psychoanalytic theory*. New York: International Universities Press.

IMPACT OF HUMAN RESOURCE MANAGEMENT ON ORGANIZATIONAL PERFORMANCE

Dražena Stanojević,
Gradska uprava Subotica
Corresponding author, e-mail stdasha@eunet.rs

Abstract: *Modern organizations are faced with numerous challenges imposed on them by changing and dynamic environment. Among the many activities undertaken, special attention should be paid to proper management of human resources. Human resources are the most important resource in the organization and a source of competitive advantage. Employees with their knowledge, skills and abilities contribute to business success and improving the performance of organizations. In the scientific theory and practice is increasingly emphasizes the importance of human resource management and its impact on organizational performance. The aim of this paper is to explain the connection between human resource management with the performance of the organization through appropriate theoretical models, as well as to show the individual results of relevant research in this area. In the case of Spanish companies will show how the training of employees as a human resources activity has positive influence on individual and organizational performance and growth of the company.*

Keywords*: human resource, human resource management, organizational performance, training*

1. INTRODUCTION

Organizations should recognize importance of human resource as a source competitive advantage. People with their skills, knowledge and abilities represents critical factor for business success. Human resource become more important as business environment become more competitive. Globalization, permanent growth of inovation, and technology, knowledge-based economy are contemporary trends that impact on individual and organizational performance. This paper will explain the concept of organizational performance, the importance of human resource management to improve organizational performance, and consequently business performance of organizations. You will examine theoretical models explaining the link between human resource management and organizational performance. With regard to the training of employees is an important activity human resource management, the research results show the Spanish authors explaining the positive effects of training employees on organizational performance.

2. HUMAN RESOURCE MANAGEMENT AND ORGANIZATIONAL PERFORMANCE

Performance management is a “continuous process of identifying, measuring, and developing the performance of individuals and teams and aligning performance with the strategic goals of the organization ”. (Aguinis, 2009 , p. 3). The key components of this definition are that this is a continuous process and that there is an alignment with strategic goals.

2.1. Term and definition of organizational performance

According to Enos (2007), organizational performance is related to defining and achieving specific goals, although different definitions can be found in literature.

Table 1: Definitions of organizacional performance (source Enos, 2007.)

Author	Definition	Contribution
Enos (2007)	Organization performance are indicators and progressive achievement of tangible, specific, measurable,worthwhile and personally meaningful goals.	Definition and selection of quantitative indicators.
Parmenter (2010)		

	The organizational performance is marked and classified by success indicators, performance indicators and key performance indicators as key success indicators. The fundamental success factors are the list of problems or aspects of organizational performance that indicate the vitality of the organization, its state and success.	Key indicators of organizational performance
Franceschini, Galetto and Maisano (2007)	Measuring organizational performance reports on the long-term process of continuous monitoring and reporting on achievements, especially of the pre-defined aims. The measures of organizational performance can be related to the type or level of process, direct output results.	Observation of everything that the measures of organizational performance can relate to.
Buble (2006)	Taking into consideration the effects of performance represents the beginning of the business process transformation. One of the aims of improving business processes is to determine economic sense that the changes will bring, which is not possible without measuring performance.	Quantifying the economic sense of changes.
Jeston i Nelis (2008)	If business performance is not measured, you cannot manage your business. To measure performance means to know and to be able to make a decision in certain circumstances.	The importance of measuring performance in the context of making good business decisions.
Davenport (1993)	Actions are important, but they will not be taken unless everything is directed towards improving the process.	Discusses performance problems.

2.2. Linkage between human resource management and organizational performance

In recent years, scientists have devoted great attention to examination of the relationship between human resource practices and organizational performance. Based on previous research until today, it becomes increasingly clear that the system of human resources is an important component that helps the organization to be more efficient and achieve competive advantage.

Develop organizational skills by learning from the past, present and adaptation to create the future on the basis of predictions. The competitive advantage of the company is that these features needed to create recombine and transform the organization in the context of a dynamic competitive environment. Problem creating a model from strategy HRM-firm-performance is difficult because of the dynamics that exists in environment and affects organizational skills.

In the scientific theory and practice, there is a growing interest in understanding connection between HRM and organizational performance. In analysing the impact of HRM on organisational performance, each of the HRM-performance linkage models developed complements the others by adding constructs, variables or relationships (Alcazar, Fernandez, & Gardey, 2005).

Resource based view is an appropriate theoretical framework that describes the proper relationship model relationships between strategy, HRM and performance. Given the complexity of the relationship, this relation has been recognized as the "black box".

According to Guest (1997), there is a need for theory on performance, theory on HRM and theory how the two are linked. The theory proposes that performance at individual level depends on high motivation, possession of the necessary skills and abilities and an appropriate role and understanding of that role. Only HRM practices that encourage skills,motivation and appropriate role structure impact HRM outcomes. These factors influence behaviour outcomes, which translate into performance outcomes, which result in financial outcomes (see the next figure).

HRM strategy (differentiation, focus, cost) ➔ HRM practices (selection, training, appraisal, rewards, job design, involment,status and security) ➔ HRM outcomes (commitment, quality,flexibility) ➔ Behaviuor outcomes(effort/motivation, cooperation,involvement, organizational citizenship)➔ Performance outcomes(high: productivity, quality, innovation; low: absence, turnover,conflict, customer complaints)➔ Financial outcomes (profits,ROI)

Figure 1: Guest model HRM- performance

This model suggests that business strategies drive the design of the HR system. HRM practices directly impact employee skills, employee motivation and work design which consequently influence employee's creativity, productivity and discretionary behaviour. These variables, in turn, result in operational performance, which relates to profitability and growth, ultimately determining firm market value (Gardner *et al.*, 2001).

Model of Becker (1997) suggests that business strategies drive the design of the HR system. HRM practices directly impact employee skills, employee motivation and work design which consequently influence employee'screativity, productivity and discretionary behaviour. These variables result in operational performance.

Business and Strategic Initiatives ➔Design of HRM System ➔Employee skills, Employee motivation, Job design and Work structures ➔Creativity, Productivity, Discretionary Effort ➔Improved Operating Performance ➔Profits andGrowth ➔Market Value

Figure 2: model HRM- performance by Becker

The People-Performance framework (Purcell *et al.,* 2003) is built on two assumptions:
1) the framework advances the concept of discretionary behaviour by suggesting that virtually all employees have the capacity to engage in discretionary behaviour;
2) the critical role of line managers because they have discretion in the way that they apply HRM and the way they behave towards employees.

These model also focus on abilities, skills and motivation of employess and opportunities to participate (Boselie, 2010).

Wright and Nishii (2006) examined some of the mediating processes that might occur in HRM-Performance relationship by examining the relationship at multiple levels of analysis. They present the model that includes intended HR practices, actual HR practices, perceived HR practices, employee reactions and performance (see Figure 3).

Intended HR practices ➔Actual HR practices Perceived HR practices ➔Employee reactions (affective, cognitive behaviour) ➔ Organization performance

Figure 3: HRM- performance link model by Wright and Nishi

3. HRM-ORGANIZATIONAL PERFORMANCE RESEARCH BASED ON SPANISH FIRMS

Among the many activities of human resource management that have a critical impact on organizational performance highlights staff training. In changeable conditions imposed by a dynamic environment, organizations need to pay special attention to the development of intellectual capital. Training is an essential activity of human resource management. Expansion of training in organizations reflects its potential use as a means to improve the development of human capital and the enterprise. However, research regarding the

effects of training in the practice of late in some way and it is necessary to establish a theoretical framework to explain the training process and its results.

Spanish authors Núńez-Cacho P., Grande F., Lorenzo D. (2015) have conducted research on the effects of training on organizational performance. The main contribution of this research is to improve the training and knowledge of its basic characteristics.In addition, analyzes its impact on employees and organizations and identify factors that can affect the efficiency of this type of training. As for the implications, this study provides valuable guidance to help managers in the assessment of investment in training and orientation in human resources planning strategies in their organizations.

The questionnaire was sent to managers of human resources in the 2,303 Spanish companies. In order to collect the information needed for research, companies are selected from the Spanish business register.The response rate was 21.6% and in the stydy participated 498 companies. The confidence level of the sample is 95% and the margin of error is 3.96%. As a control varijebile were used medium-sized companies (in terms of number of workers whose average is 174), and the average age of the company (35 years). The study companies from the following sectors: industry (39%), trade and services (37%) and the primary sector (24%). Even 91% of the companies surveyed fully implement training programs.

The questionnaire was developed based on a review of existing literature in order to obtain information necessary for solving research problems. The variables that were used in the study are:

- Organizational support and precondition
- Training
- Individual performance oh human resource
- Organizational performance
- Sales growth and productivity.

As a control variable were used medium-sized companies (in terms of number of workers whose average is 174), and the average age of the company (35 years). The study companies from the following sectors: industry (39%), trade and services (37%) and the primary sector (24%). Even 91% of the companies surveyed fully implement training programs.

Given that in the scientific literature there is no consensus around considerations of training effectiveness, the authors define it in the study tested four hypotheses:
1) Hypothesis 1: Organizational Support improves individual performance human resources in the company;
2) Hypothesis 2: training improves individual performance of the human enterprise resource;
3) hypothesis 3: Improvements in individual performance as a result of the training has a positive effect on organizational performance;
4) Hypothesis 4: Improvements in individual performance as a result of the training has a positive effect on the growth of the company.

Table 2: Corelation and Cronbach alpha (diagonal) for measurements scale

	Organizational support	**Training**	**Individual performance**	**Organizational performance**	**Sales growth and productivity**
Organizational support	**0.77**	-	-	-	
Training	0.49	**0.94**	-	-	
Individual erformgance	0.41	0.40	**0.71**	-	
Organizational performance	0.36	0.44	0.31	**0.81**	
Sales growth and productivity	0.26	0.38	0.38	0.33	**0.77**
Varians	0.55	0.67	0.52	0.71	0.81

Source : Núńez-Cacho P., Grande F., Lorenzo D.,(2015), „*The effects of coaching in employees and organizatinal performance*“, Intagible capital, 11 (2), p. 166-189, downloaded 15.01.2016.ca http://www.intangiblecapital.org/index.php/ic/article/view/586/464

Overall, scala has realibility α = 0,711 and r = 0,728 which is acceptable for investigative srudy, a composite index of reliability in accordance with the recommendations.All relations are recognizable. Therefore, the assessment index indicates good agreement on the basis of accepted criteria.

The research results make it possible to infer that the processes have become the medium of training is useful for the development of professionals in the organization, as found effect on the performance of human capital. Training helps organizations to improve their competitive position through the impact on organizational performance, increase sales and productivity growth. On the one hand, managers can benefit from the training process, and to exploit the potential of human resources of the company. On the other hand, a relevant contribution of this research is the positive effect of the training process in the organization, which can be measured in terms of the results of the company and its growth.

4. CONCLUSION

As organizations strive to compete in the global economy, differentiation on the basis of the skills, knowledge, and motivation of their workforce takes on increasing importance. In theory and practice of management, is increasingly emphasizes the importance and impact of certain activities of human resource management on the performance of the organization. According to the modern understanding of "strategic partnership" human resources function needs to have both strategic and operational focus and at the same time takes into account the systems and people. Then human resource management is not only a link between the strategy and the expected performance of the organization on the one hand and the needs of employees and their individual performance on the other hand, it is an integral part of the formulation and implementation of business strategy. Adequate training programs and the development of human resources lead not only to changes in reaction, attitudes, knowledge and behavior, but also to improve the results of the work of individuals and beyond that to the better performance of the organization expressed a variety of key performance indicators such as productivity growth and / or reducing absenteeism or staff turnover, improve the quality of products or services, reduce costs and / or increase the profits of the company. Organizations need to understand that human resources management is an important segment of business strategy and a source of competitive advantage. Numerous studies in theory and practice have shown that there is a correlation between the practice of human resources and organizational performance. Research conducted by Spanish autors show that exists positive relations between training (as an important part of HRM) and organizational performance. In the opinion of the author of this work in the future is even more expected expansion of research on the impact of HRM on organizational performance.

REFERENCES

Aguinis , H. (2009). *Performance management* (2nd ed .). Upper SaddleRiver, NJ : Pearson Prentice Hall .

Becker, B. E., Huselid, M. A., Pickus, P. S., & Spratt, M. F. (1997). HR as a source of shareholder value: research and recommendations. *Human Resource Management, 36*(1), 39-47.

Boselie, P. (2010). High performance work practices in the health care sector: a Dutch case study. *International Journal of Manpower*, *31*(1), 42-58.

Enos, D. E. (2007): *Performance Improvement*, *Making it happen,* 2nded. Auerbach Publications, New York

Guest, D. E. (1997). Human resource management and performance: a review and research agenda. *The International Journal of Human Resource Management*, *8*(3), 263-276.

Núńez-Cacho P., Grande F., & Lorenzo D.(2015).*The effects of coaching in employees and organizatinal performance*. Intagible capital, 11 (2), 166-189. doi:10.3926/ic.586

Peña Garcia Pardo,I.,& Fernández Moreno, M.V. (2009). Looking into the black-box: analysis of the effectiveness of human resources strategy. *Zbornik radova Ekonomskog fakulteta u Rijeci – Proceedings of Rijeka Faculty of Economics,* 27(1), 31-56.

Purcell, J., Kinnie, N., Hutchinson S., Rayton B., & Swart, J. (2003). *Understanding the people and performance link: unlocking the black box*. London.

Ralević, P., Dragojlović, A., Dobrodolac, M. Denić, & N., Nešić, Z. (2015). Poboljšanje organizacijskih performansi upravljanjem ljudskim resursima, *Tehnički vijesnik*, 22, 2(2015), 263-269.

Savaneviciene, A., & Stankeviciute, Z. (2010). The Models Exploring the “Black Box” between HRM and Organizational Performance. *Inzinerine Ekonomika-Engineering Economics*, 21(4), 426-434.

Smither, J., London, M., (2009). *Performance managememt: putting research in action*. Jossey-Bass, A Wiley imprint, San Francisco

Wright, P. M., & Nishii, L. H. (2006). Strategic HRM and organizational behaviuor: integrating multiple levels of analysis. *CARHS Working Paper Series,* 05.

SPIRAL DYNAMICS AS VALUE SYSTEM AND COMPETITIVE ADVANTAGE OF AN ORGANIZATION

Dusanka Rodic *[1],
[1] University of Belgrade, Faculty of Organizational Sciences
Corresponding author, e-mail: dushka_rodic@hotmail.com

Abstract: *This paper aims to discuss the Spiral Dynamics as both theory of value system and usable tool for organizational competitive advantage. Spiral Dynamics is a framework for understanding the dynamic forces that drive people to action in personal lives, business relationships, education, and even geopolitics. The theory of spiral dynamics can be seen as a model for understanding complex values and beliefs that encourage people to different behaviours, but t can also be considered as a tool for managing differences between people and differences between people's value systems and organizational value system. The theory of Spiral dynamics is very wide and complex subject to discuss, but in this paper it will be described just essentials for understanding the whole concept, what is Spiral Dynamics about, some main principles of it, how is could be applied to organizational efficiency and effectiveness and make a competitive advantage of it.*

Keywords*: values, beliefs, vMEME, value system, organizational value system, motivators on spiral, value fit as competitive advantage*

1. INTRODUCTION

The person who is responsible for the foundations of Spiral Dynamics is professor Clare W. Graves. He was professor of psychology of Union Colleague, New York. Professor Graves was disappointed with psychology as science back then. He had found lots of mess and inconsistency and even contradictories in psychological data and theories, and it led him to go to adventure of researching. Professor Graves initiated research project, wanting to find out which is prevailing worldview among people. The main question he asked was: "What is that characteristic that makes mature, grown-up human personality". His research lasted for thirty years. Data he got in his research, Graves benchmarked with the date of other scientists. After thousands of interviews worldwide, Graves developed a theory which he called: "The Emergent, Cyclical, Double-Helix Model of Adult Biopsychosocial Systems Development." He later modified the name as "The Theory of Levels of Human Existence." Graves (1973) summarized his theory in this manner: "Briefly, what I am proposing is that the psychology of the mature human being is an unfolding, emergent, oscillating spiralling process marked by progressive subordination of older, lower-order behaviour systems to newer, higher-order systems as man's existential problems change." Even today, his opinion and theory are considered advanced and it is more and more accepted.
After Graves, there are other people who contributed to the development of todays Spiral Dynamics theory, and its practical application on ordinary life situations. To develop the version of today's theory after Graves, many other achievements from other sciences and science disciplines are used, such as are: neurobiological science and achievements of organizational science, which no gives to Spiral Dynamics an interdisciplinary characteristic. Some of the well-known names are: Don Beck, Christopher C. Cowan, Nataša Todorović and Ken Wilber.

The name itself tells about Spiral Dynamics as non static theory, it is not determined, but evolves with the evolution of human consciousness. Humanity has the power to establish new levels of consciousness that carry withinthem the characteristic values within itself, beliefs and artifacts that together create totaly new value systems.

2. SPIRAL DYNAMICS THEORY

2.1. Definition

Spiral Dynamics is the most modern, most comprehensive and most respected psychological theories, which combines the 'bio', 'psycho' and 'socio' aspects of human functioning. (Beck and Cowan, 1996) stated that It

gives us a scientifically based way of thinking about the complexity of human existence and understanding of order and chaos in human relationships. Explains the deep forces in human nature that shape our values and representing the form and trajectory of effective change. Spiral Dynamics provides a greater understanding of how people, organizations and entire cultures work from the inside out or herself is a very versatile tool that allows people to work, study and live with better quality of life and to be more successful.

Spiral Dynamics is:
• a way of understanding and predicting changes in response to these changes,
• also a way of understanding the 'why' people think the way they do,
• a model of development of human value system,
• a framework for understanding organizational development,
• a mechanism for assessing the appropriateness of changes
• a human factor that is missing in the process of business restructuring,
• an effective framework for guidance - for understanding complex situations and create new relationships,
• a framework that the best way fits other systems, models, approaches or interventions
• the development model of human nature, not just out of where it comes what we think is worth, but also out of where our values and thinking come and which directions they go.

2.2. Six dimensions of value system

Six dimensions of value system are: semes, themes, mindsets, world views, ᵛMEME and gens.

1. Semes - words, symbols, icons (pictures) and objects that are related to ᵛMEME.

Schemes are what is tangible. These are: words, music, literary metaphors, icons, paintings, artifacts, and other "concrete" objects that are the final products and specific packages of stored ᵛMEMEs. It can be, for example: symbols such as Christian Cross or the Star of David; political campaign slogans or props; flags, logos and markings; fashion and dress codes; colored gangs and their behavior; musical styles, the lyrics, melodies and rhythms; Personal possession (cars, houses, collectors' items and status symbols); architectural styles and living spaces; Technology and gadgets in all forms.

2. Themes - Questions (outcomes) causes and events that formed around the meme energy field

Topics are what is intangible. The idea, cause, reason, question, position or event that is attracted by the ᵛMEME and the one where ᵛMEME also put its core intelligence in. This then becomes the theme of a representative or transferor for that specific Meme, for example: religion, political affiliation, socio-cultural movement, a philosophy, a symbolic event, a celebration, etc.

Together, Schemes and Themes are called “memes” according to Richard Dawkins (1976) and other in “memetic” literature. The idea behind the” Meme” is self-repeating package of information that is propagated through the ecology of the mind in the forms of reproduction similar to viruses. Parallel structure in biology is gen. In chaos theory, the parallel structure of the fractal. In the language of Spiral Dynamics, "a great meme" - value MEME or we will call it ᵛMEME - the process by which people become closer to it, drawn to it, and then eventually take them away from Themes and Schemes category so called "Little memes".

3. Mindsets - online, constantly present active, dominant ᵛMEME(s) in certain situation

Activated ᵛMEME(s) and "on-line" world view are employed in a particular moment of judgment. It will be shaped by previous experiences, the relative priority clusters of ᵛMEMEs of that person and the unique properties of the message or stimulus that activates and focuses the mind. Think of memes as "hot" and "cold" buttons that can be artificially manipulated (to some extent) with the agents of change that would affect on which of the ᵛMEME to use in the act of interpretation and judgment. How can ᵛMEME(s) come and go, to shine and to fade out in terms of priorities, the persons ways of thinking are designed with a special ᵛMEME which is activated at a specific time and a specific place and will reply on specific living conditions.

4. World views - repertoire range of all awakened, available ᵛMEMEs
   - Cluster all available memes that recognizes the mind (that are in it)

   View of the world is made up of the repertoire meme (that had been awakened) with their relative strengths and significance. Find itself in a view of the world:
   - epistemology-way knowledge.
   - Community FILTER AND EDITORS (both conscious and unconscious) that sieved and sorted input.
   - Sets of evaluative filters and editors (both conscious and unconscious) to sift and sort input
   - Built in priority stack or cluster that exists in varying degrees of strength and relevance when a person/organization/society is in a “idle” position (before a mindset-focusing stimulus) and which orders inputs.

- Ways of interpreting themes and connecting with Shemes
- Lenses that magnify or minimize events in the perceptual world.

- Process of pattern recognition and scanning for relationships.
- Structures of like/dislike, approach/avoidance, and live-for/die-for causes.

5. ᵛMEME(s) - the Core Intelligence within the Biopsychosocial System's "DNA", are:
   - A "bottom line" for human existence.
   - A rationale for why thing happen.
   - A Level of complexity of functioning.
   - A Neurological capacity to detect and deal with a specific set of life conditions.
   - A range of development from low to high elaboration.
   - A Closed, Open, and Arrested condition (within the situation and context).
   - A specific package of approaches to emotions and feelings.
   - A concept of time and place.
   - A locus of control (from inside or outside).
   - A degree of predation or proliferation (how driven to spread outward like a virus or consolidate. inwardly; how much to move beyond boundaries or to operate within the boundaries).
   - A particle-field focus between concentration on individual particles *(elites)* or the entire field *(collectives).*

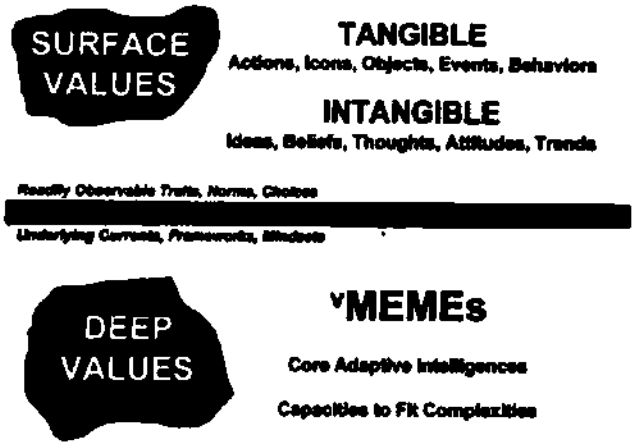


Figure 1: Structure of ᵛMEME, Adopted from: National -Value Center, Inc. Denton TX, Spiral Dynamics Integral Level I Certification course materials

6. Gens - The individual and collective biological genetic pools
   - A Closed, Open, and Arrested condition/capacity (within the person)
   - Personality - temperament and texture attributes
   - Physiological characteristics and traits
   - Propensities toward intelligences and capacities

2.3. Five deep strata which shape value system

Five deep strata of value system consists of, on the first place: Life conditions (internal and external), which when any change occur in them, it effect on Genetic and Memetic codes (in people), than as chain reaction it affect on Minds and ways of thinking, than it again has effect on Systems and structures, and finally it is noticeable in change of our actions and behaviors.

Different life conditions activate different value system ᵛMEMEs. According to professor Graves (1970) life conditions are the real activators of ᵛMEMEs and his research suggests eight main value systems which evaluated until today. They are reactive, traditionalistic, exploitive, scarifying, materialistic, sociocratic, existential and experimental.

Table 1: Existential states, associated motivational systems and end values;
Adopted according to table from the article: Graves, Clare W.,"Levels of existence: An open System Theory of Values", Journal of Humanistic Psychology, November 1970, Vol. 10, No.2

Existential state*	**Motivational system**	**Means values****	**End value****
H-U	Experience	*Experiencing*	Communion
G-T	Existence	Accepting	*Existence*
F-S	Affiliation	*Sociocentricity*	Community
E-R	Independence	Scientism	*Materialism*
D-Q	Security	*Sacrifice*	Salvation
C-P	Survival	Exploitation	*Power*
B-O	Assurance	*Traditionalism*	Safety
A-N	Physiological	No conscious value system; values purely reactive	

*A-N: a psychological system: B-O/H-U: psychological systems.
**Italicized values: primary orientation on each value system.

[v]MEMEs awakened with certain life conditions are found in: people, organizations and entire societies.

2.4. Spiral with characteristics

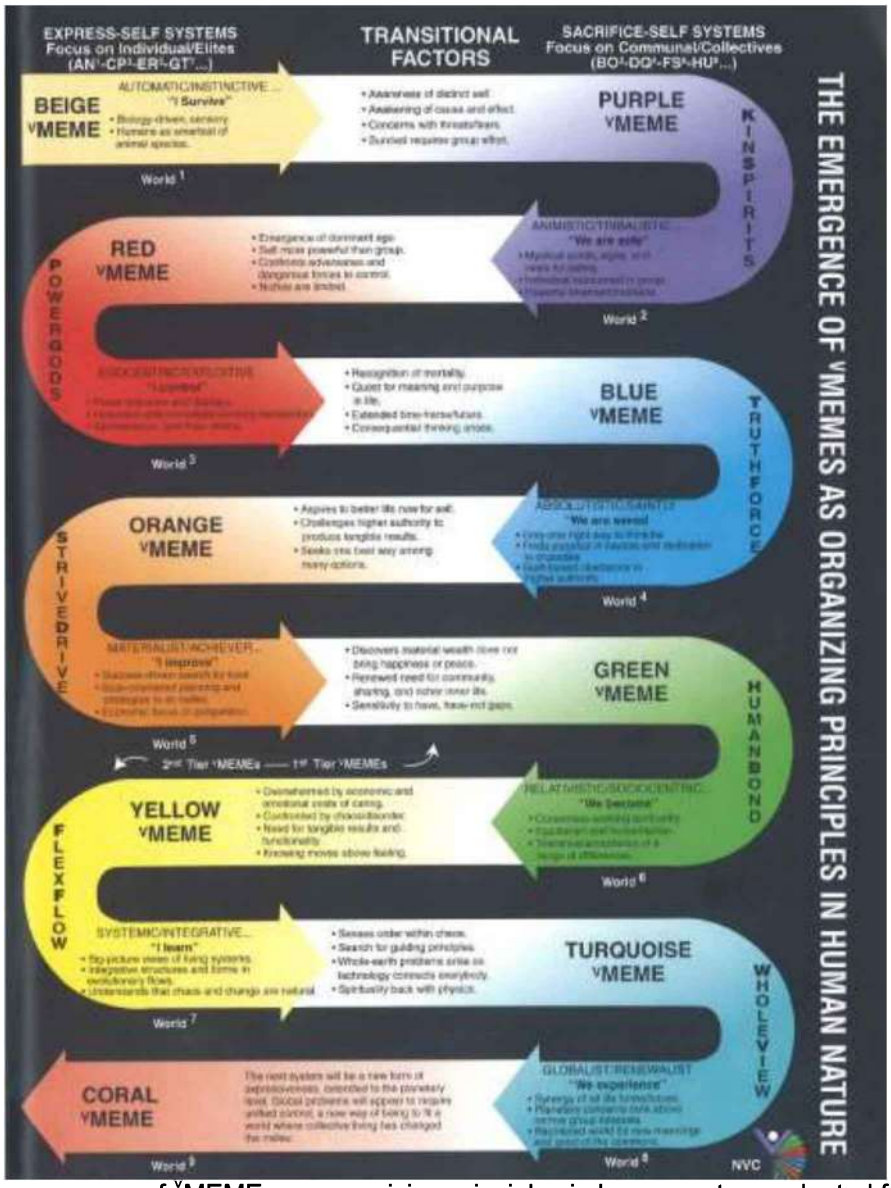


Figure 2: The emergence of [v]MEMEs as organizing principles in human nature, adopted from: National - Value Center, Inc. Denton TX, Spiral Dynamics Integral Level I Certification course materials

3. SPIRAL DYNAMICS AND ORGANIZATION

According to (Beck and Cowan, 1996) organizations are structures in our mind. The words printed on the charts projected onto the walls, symbols and actions around the neck, and areas occupied as a manifestation of power are nothing else but the artifacts and icons. Really genuine, real connections are within the ˅MEMEs in profile of people who are part of this organization, this invisible network that command ordered society and relationships. We carry them around in our heads at any moment. Each location along the Spiral has its own mental configuration as the range of radar, where the contours are drawn being ideal life. Which circle on the radar scope is the most important depends on which meme active. Then our radar screen looks like this:

BEIGE ˅MEME: to care about bread and butter issues of survival at its most basic level.
PURPLE˅MEME: as a magical circle that makes everyone feel safe within it.
RED ˅MEME: self-centered as an empire where one feels powerful and controls weak and subordinate.
BLUE ˅MEME: as a fixed pyramid, which provides stability, durability and assigns each place.
ORANGE ˅MEME: as a matrix of the playing field that promotes opportunities and rewards capabilities.
GREEN ˅MEME: a warm supportive community of equal who care about each other.
YELLOW ˅MEME: as a floating network that transfer functions above, below and between natural layers.
TURQUOISE ˅MEME: as a living organism that brings order internally (within the chaos).

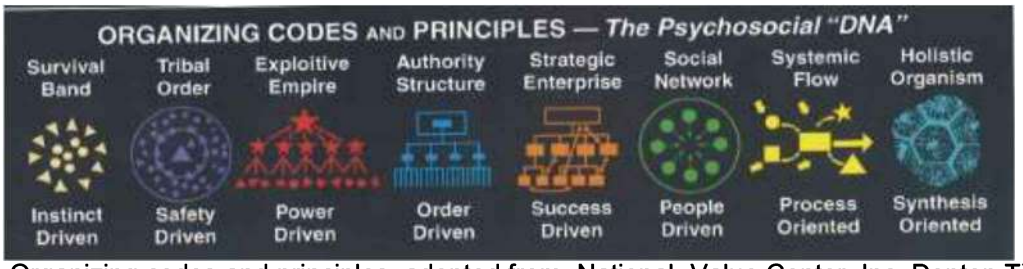


Figure 3: Organizing codes and principles, adopted from: National -Value Center, Inc. Denton TX, Spiral Dynamics Integral Level I Certification course materials

3.1. Spiral Dynamics and leadership

Leadership as the ability to translate vision into reality according to (Bennis, 1961). If just the leadership based on the results, is taken into consideration, than the highest quality is selected from short-term and long-term results achieved "leaders with clearly articulated set of values" (Ulrich, Zenger and Smallwood,2013). Leaders who understand their personal values, their organization achieve lasting results. In the absence of clearly defined values, leader with no real vision is constantly changing his goals, so the direction for the organization is not clear as well.

Some principles of Spiral leadership:
1. Different organizations have different positions on the Spirals, therefore, need to develop management strategies that align people, the vision of the future and the work currently performed.
2. Managers should develop a consistent, comprehensive approach to every issue within the Organization - the selection, hiring, positioning, training, internal management and external marketing - so that all these elements are balanced, integrated and unified in its effect.
3. Organizations should be designed in such a way from "top to bottom and from the bottom up" to link the functions, logistics and decision-making structure so as to prepare for the new complex problems.
4. Successful organizations may be at risk of failure if they continue to lead the people in a way that made them successful in the past.
5. Many people today should lead and manage differently, because they can be placed at different levels on Spiral and can move faster than most of their bosses, teachers or parents.
6. Marketing strategies often fail because the designers transfer their value systems on the public assuming that these people have the same values as they do.
7. It is not a question of 'how to motivate people?' but how you treat what you are doing in relation to their natural motivational currents. A person has a right to be who he/she is.
8. Today's problems with productivity, quality, political instability and restructuring are signs of growth, not decline. This will force us to find new and innovative ways of managing people, based on what these people have now already become.

3.2. Motivators according to the Spiral levels

vMEMEs	HOT BUTTONS	COLD BUTTONS
BEIGE	offer food, water; sex; input through basic senses; touch {if safe); caress to give reassurance; recognize the intelligences which are there	withdraw food or make threatening moves; cause physical pain or discomfort through temperature: .' thirst; treat as animal-like being
PURPLE	rituals; respect for powerful figures; appeals to safety, magic, mysticism; traditional ways and customs; home and hearth; desires of spirit beings, signs and omens; give tokens & tangible goods; respect elders; show honor to ancestors	speak ill of the chief or tribe; step on or desecrate sacred grounds; violate taboos or ritual ways; introduce ambiguity; isolate and force accelerated change and uncertainty; threaten family; disrespect eiders or ancestors; don't try to understand
RED	immediate payoffs; macho appeals, challenges, and dares; heroic images; more clout and personal power; looking good and getting due respect; gaining control over nature and other people; getting by with something; prizes and rewards—NOW	challenge power or courage; shame or put down person/group; move onto turf uninvited; display more powerful weapons; make gestures and name- call; be derisive and laugh; make to lose face; taunt as an outsider; appear or talk weak; make excuses
BLUE	duty, honor, country; *semper fr,* righteousness; obedience to. higher authority; being prepared; sacrifice and discipline; rewards for dedication to come in the afterlife; stability/order; purpose; standards & norms; finding greater meaning; being a good citizen; punctuality	attack religion, country, or ethnic heritage; desecrate symbols or Holy Books; put down the One-True-Way or make fun of it; violate chain-of-command; disregard rules and directives; appear unfair or sleazy; be wishy-washy; use bad" language; demean the standards; be late
vMEMEs	HOT BUTTONS	COLD BUTTONS
ORANGE	opportunities to succeed; progress, growth, winning, achievement, making things better; competitive edge & advantages; bigger-and- better, new-and-improved; state-of-the-art; fashionable; prevailing through experience, calculated risks & good science; cutting-edge; make deals & bargains; treat like VIP	put down profit or entrepreneurism; talk about collectivization accuse of games and demean .outcomes;challenge compulsive drives; deny rewards for good performance; force sameness; cost prestige; trap with rules and procedures; fail to bargain or negotiate; seem inflexible; treat as one of the herd; seem ordinary
GREEN	participation and involvement; consensus decisions; teamwork; liberation of the oppressed; sharing; acceptance of human weakness and foibles; openness; environmental sensitivity; tolerance; political correctness; inclusion; social responsibility and awareness; participation; corporate citizenship; community involvement	assault the group's goals and ideals; try to get centralized control; divide the group; reject collective for individual accountability; support aggressive competition; deny affect and feelings; degrade quality of life or environment; appear cold-blooded; appear mercenary; rely on "hard facts" to the exclusion of people factors; act elitist or exclusive
YELLOW	liberate to be and do as one chooses; learning interesting things to enhance quality of being; access to diversity in people, choices, and big- picture views; enhancing competency and functionality; principles and "what's right" tries to produce in appropriate and sustainable ways; demonstrate linkages & interconnections	force rules without reasons; impose dysfunctional structure; focus on minor details; be punitive; deny individual control of time; make work repetitive; close access to varied information or learning resources: try to homogenize; knowingly harm people or the environment; pass the buck to the future; force groupness; ignore diversity of thinking
TURQUOISE	experience *of* being above self-interests and even group pressures; to find unity in ideas and goals of whole-Earth impact; responsible to the overall good; complex, multidimensional thinking; survival of life on the planet; interactive holism; interdependence; to form groups of individuals; appreciates the spiritual side of things	hide reality; set short-term goals at expense of living system in the long-term; enforce narrow views about ethnicities, ideologies, and political conflict, deny spirituality; make self-serving excuses; leave residues; seek advantages through deception; appear mundane; take a narrow view; put up with destructive forces; take the easy course; be too earthbound

Figure 4: Motivatos and "cold buttons" for each Spiral level, adopted from: National -Value Center, Inc. Denton TX, Spiral Dynamics Integral Level I Certification course materials

3.3. The example of application of Spiral Dynamics on organization as its possible competitive advantage

It is known that the corporate culture can affect company's success both in a positive and negative way. Clearly defined values shared with the employees that are followed within the company have proven decisive factors the level of success of the company (Krumm and Rainer, 2012).

This is 5 years old practical example from my working experience. Client's one branch office of one well known pharmaceutical company - leader in pharmaceutical innovations and development of new technologies – Abbott , had to choose candidate for marketing manager position for that branch office and that country. In the pictures below is shown final check of just one candidate C2 (because of the privacy of people and company).

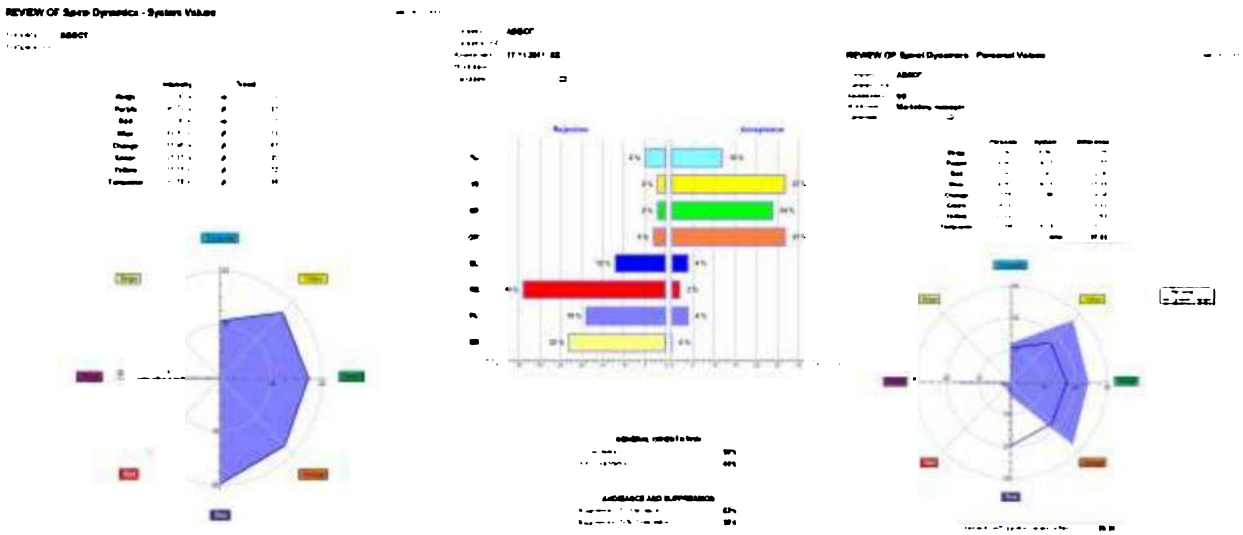


Figure 5: (from left to right) Company's value system; Candidate's value system; Candidate-organization fit

As we could see on Picture 5, last diagram shows us value fit between organization and candidate C2. What we can see from it is that similarity of value pattern of candidate with the value system of company is 86.36 %, which is high score. We can also see that with 10% candidate differentiate from the pattern of organizational value system. When we look at the diagram, we clearly see that the candidate has a greater presence of orange, yellow and green ^{V}MEMEs comparing to the organization. Then let's see the workplace, the position of the Marketing Manager. If we remember that if person should be a manager, it is good to take care of people, considering all people to have same rights and starting points, social care and etc., and it can all be found in green ^{V}MEME, and because of that it actually leads to the conclusion that this is not the perfect fit but this is preferable for candidate, to have more green than organization. If we now remember that marketing is an eternal struggle that by marketing research activities organizations are trying to ensure competitiveness in the market and that our orange ^{V}MEME gives us competitive spirit, ambition, initiative, relying on knowledge and science, we can here conclude that it is good if the marketing manager for its function and requirements of workplace to has more orange in the present value system rather than a company, because he/she is the one who pulls the company to continue to develop value system and be more competitive in the market. The last one, yellow ^{V}MEME where a candidate has more developed and present than the organization. Yellow ^{V}MEME -system flows, saving resources, continuous improvement, and the ability to look at all previous levels to spiral in the organization and the people, again impose the conclusion that if candidate or employee does not match 100% with the organizational value system , this exactly could be the competitive advantage of this organization.

4. CONCLUSION

This paper aimed to introduce to the reader the theory of Spiral Dynamics from the roots of its origin to its application to individuals and organizations or organizational development, as well as to show the adjustment of employees to the organizational value system and vice versa. In case of adapting the organizational value system to the employee's is more in the case of adjusting the value system of individuals who are the initiators of further organizational development, such as organizational leaders, or change leaders for example.

Throughout this paper is tried to make closer the development of the Spiral Dynamics theory, but also its dynamic character, its specific "never-ending" characteristic, because of the constant evolution of living beings on Earth and evolution of individual, social and collective consciousness .Value systems typical for any period of human development from the very beginning until now, are codes engraved in human bio-psycho-social "DNA" , and in every moment of changing living conditions they are adapting to the constant social changes and changes in information technology. Those value system changes and adapt to new era phenomenon are deeply affecting behavioral patterns and forming the new ways of social interaction, but also new forms of existence and personal development of individuals.

Thus, four-dimensional, powerful, this theory of Spiral Dynamics justifies its emergence from numerous psychological theories unified with the other sciences research, giving us the most complete picture of how deeply engraved artefacts, symbols, traditions, ways of thinking, systems and structures can respond to changes in living conditions and circumstances surrounding triggering an avalanche of predicted behavior patterns characteristic to the dominant value system.

Knowing the dominant value system of the individual, we can predict his/her reactions in certain circumstances, as well as its drivers but also what discourages him/her. Also, knowing the dominant value system of an organization, we can assume or even we can easily describe the organizational culture, both visible symbols on eyesight and also the deep beliefs which are shaping organizational culture to be as it is.knowing then, both the value system of the individual and the organization, it could be possible to predict the chances of developing the organization and the individual, as well as to predict possible conflicts, motivation and reward systems.the other things we could do knowing both organizational and employees' value systems, we can do strategical planning, we can successfully do the alignment of the organization's vision with the vision of the individuals (employees), and we can certainly predict some of the problems that affect today's organizations.

These are mainly problems affecting domain of human resources departments in the organizations, they can be manifested in the form of employee fluctuations and absenteeism phenomena for example. Value system fit between organization and new employee could be beneficial in a way that if the fit is positive, it could help avoiding the costs of introducing new employees in workplace. From the other hand if employee does not fit well into the value system of the organization and the organizational unit to which it should belong, it could be cost for organization in a way of need for finding new candidate for this workplace and there are cost for hiring an cost for introduction to work of new employees plus cost of loosing time and money on previosu employee and its introduction to workplace.
Here in conclusion of this paper, are mentioned just a few of the possible applications and benefits of the Spiral Dynamics theory, as useful tool for predicting organizational change, its competitive advantage in the market, and also as tool to avoid major problems in the field of human resources which are nowadays increasingly affecting organizations operating in modern business environment. As the theory is dynamic, its application will never be "out of fashion" because it is closely follow human society and all the changes it faces, and then Spiral Dyanmics again develops and evolve from all the changes and leaps of human society, it is never ending circle.

REFERENCES

Beck, D.E. i Cowan, C.C.(1996), *Spiral Dynamics: Mastering Values, Leadership* , and Change, Blackwell Publishers, Oxford, 1996.

Bennis, W.G. (1961), *"Revisionist theory of leadership"*, Harvard Business Review, Vol. 396.

Grave Graves, Clare W.(1973), "Let us bring Humanistic and General Psychology Together: A research project needing to become", NIMH, 1973

Cowan, Christopher C. and Todorovic, Natasha (eds.) (2005) *The Never Ending Quest: Dr. Clare W. Graves Explores Human Nature.* Santa Barbara, CA: ECLET Publishing

Graves, Clare W.(1970), *"Levels of Existence: An Open System Theory of Values"*. Journal of Humanistic Psychology, November 1970, Vol. 10, No.2

Krumm, Rainer, (2012) *9 Levels of Value Systems; a developmental model for personal growth and the evolution of teams and organizations*, Haiger

Lee, William R., Cowan, Christopher C., and Todorovic, Natasha (eds.) (2002) *Graves: Levels of Human Existence.* Santa Barbara, CA: ECLET Publishing

Robinson, DA, Goleby, M, & Hosgood, N 2006 *Entrepreneurship as a Values and Leadership Paradigm* Paper presented to Fourth AGSE International Entrepreneurship RESEARCH Exchange 7–9 February 2007 BGSB, QUT, Brisbane

Robinson, DA, Goleby, M, & Hosgood, N (2007) *Why Orange doesn't fit well inside Blue – can the corporate entrepreneurship oxymoron be tamed?* (For presentation in Eureopan Fondation for Management Development) (EFMD) on 37th Conference for entrepreneurship, innovation and small business (EISB) in Ljubljana,Slovenia 12–14 September 2007)

Ulrich, D., Zenger, J., & Smallwood, N.(2013), *Results-based leadership*, Harvard Business Press, 2013

Whitlark, James. (2005) *"The Sequence of Archetypes in Individuation"* Dynamical Psychology: An International, Interdisciplinary Journal of Complex Mental Processes.2005. (The relationship between Graves' Theory and Jungian Psychology.)

http://www.clarewgraves.com/

http://www.humanemergence.org/coreTechnologies.html

https://en.wikipedia.org/wiki/Gene_pool

http://rationalspirituality.com/articles/Ken_Wilber_Spiral_Dynamics.htm

http://www.spiraldynamics.net/

http://spiraldynamics.org/faq_integral/

http://www.spiraldynamics.com/book/SDreview_Dinan.htm

MILLENNIALS IN THE WORKPLACE

Sonja Ivancevic *[1], Tatjana Ratkovic[1]
[1] Faculty of Organizational Sciences, University of Belgrade
*Corresponding author, e-mail: sonja.ivancevic@yahoo.com

Abstract: *Each generation has its own distinct characteristics, values and attitudes toward work. Companies need to adapt processes and procedures in order to successfully integrate diverse generations into the modern workplace. The aim of the paper is to reveal the key characteristics of Millennials in the workplace as well as main challenges they face in organizations nowadays. There is a big difference between what Generation Y expects and demands of a job and what it actually gets. In this regard, it is necessary to change the modern organizations and adjust them to meet the needs of Millennial workers which will soon dominate the workplace in numbers.*

Keywords*: workplace, human resources, Millennials, generations, employees*

1. INTRODUCTION

Members of each generation resemble each other having a number of common characteristics due to the influence of different social, economic and political events that shaped their childhood and adolescence. This usually results in the fact that each generation adopts a system of values, beliefs, expectations, and behavioral patterns that are different from previous generations' and form a recognizable generational identity (Inglehart, 1997).

However, many analysts emphasize that numerous organizations around the world have no proper understanding and knowledge of the employees who work for them, nor make serious attempts to identify the profiles of the employees. For this reason, organizations are failing to align the needs, attitudes, values and behavior of their employees with organizational requirements (Singh, Raj and Bhandaker, 2012). In the absence of such a strategy and the necessary knowledge, workers are assigned tasks, schedules and work principles which do not suit them, and for which they are, by their preferences and characteristics, in some way incompetent. Thus, managers' discontent grows and companies' objectives are not achieved while motivation of workers decreases gradually, which eventually leads to increased absenteeism and unavoidable lay-offs or resigns.

2. DIFFERENT GENERATIONS IN THE WORKPLACE

Generation Y or the Millennial Generation, is a demographic cohort that follows Generation X (1966-1979). There are no clearly defined years that determine this generation's span, but most researchers and authors use a range between 1980 and 2000 to mark the birth years of the members of this generation. Several authors use other names for this generation, such as 'Nexters ' or 'Nextus Generation' (Barnard, 1998; Burke, Cooper and Antoniuou 2015; Zemke, Raines, and Filipczak, 2013), 'Boomerang ' or 'Peter Pan' generation, as they are called by American sociologist Kathleen Shaputis (2004), because of the characteristics they have. According to the Pew research center, in 2015, Millennials made up 34 percent of the US labour force, and the same source anticipates that by 2020 they will make almost half (46 percent) of the workforce. Even more dramatic are the Brookings' numbers which claim that by 2025 Millennials will become 75 percent of the global workforce. It's worth noting that the Millennial population as a whole (not just its workforce) surpassed that of Baby Boomer generation (1946-1965) in 2015 as the nation's largest living generation.

In this regard, it is necessary to deal with the generation Y thoroughly at both global and regional levels, and make the necessary changes in the approach and motivation of employees in order for the business world in every industry to continue to operate at an optimal level.

Organizations expect employees to obediently adapt to work, their work roles and the existing organizational culture, rather than to adjust organizational processes to the expectations and needs of the people who work there. This would not be the biggest of a problem if it was not for one of the main characteristics of the youngest working cohort, which is ''disobedience''. Or at least it is perceived as such.

They are perceived as outrageous, lazy, spoiled and egoistic. They are considered to have no work ethic and are not loyal to the organization they work for. In the eyes of their predecessors they have no respect for authority, are unprofessional, too relaxed and have poor communication skills on one hand, and on the other hand are very demanding with a lot of unrealistic expectations (Tulgan 2015). Nevertheless, this infamous generation is spreading its wings in the workplace, outnumbering Gen X and Baby Boomers in the business world and outside of it. And who are they? They are Millennials! They do not ask for permission, they are blind to hierarchy and, avoiding false modesty, they claim what they want from scratch. And, what do they want? They want answers, flexibility, continual feedback and mentorship. They want meaningfulness, team work and to be heard. Most importantly, they want their life and they do not compromise about it. Unlike their parents. Unlike their grandparents. How bold is that? Should their managers let them get away with it? Well, if they want their companies to work after they have retired, if they want to boost their business and stay competitive in a global market, and, if they want to create a survivable, let alone positive work environment, then the answer is yes, they probably should.

Those companies that find a way to work with Millennials without diminishing performance standards and the quality of work will have a strategic advantage on the market. Having acknowledged that the problem exist, business experts around the globe have started to bust the ongoing myths about Millennials and to take a different, more positive approach to them, in order to bridge the gap between the cohorts and find a constructive way to work with Millennials and ensure the future of their own business.

During the last two decades, a large number of researches and studies on Generation Y have been conducted, especially on the western hemisphere. Different authors rely on the data from numerous works on this topic (Singh, Raj and Bhandaker, 2012; Barkin et al. 2010; Deal, Altman & Rogelberg, 2010; De Hauw & De Vos, 2010) in order to show that this generation differs from the previous by its system of values, aspirations, goals, priorities in life and lifestyles. Taking it into account, the integration of Millennial generation into the business culture created by the baby-boomer generation (Baby Boomers) is not an easy thing.

First of all, in order to better understand this generation, we need to consider the main factors that shaped their childhood and growing up, namely: globalization, technology, uncertainty of institutions, digital environment and diversity. Also, two micro trends that have formed them, particularly stand out, and these are: helicopter parenting and virtual reality (Tulgan 2015).
Let's start from the last.

Helicopter parents usually do everything for their children. They organize or structure their time from the morning to the time they go to sleep, carefully planning their activities, leaving them no much space for free play and the like. They also resolve conflicts for them, either because 'they are trying to help or don't have time for their children to take up their time to work it out' (Caraher 2015). Even though or because of the fact that they are raised in completely opposite way, most of the parents, who belong to Baby Boomer or Generation X, are overprotective, stroking egos of their children for participating, and not for accomplishing tasks properly, let alone winning, which is one of the biggest differences. Older generations weren't commended until they have won something, got all the best grades, completed any of the tasks really well and were exceptional. They were also strongly criticized for not behaving properly, not doing their best, not putting enough effort into what they did, etc. The same goes for the patronizing behaviour of Millennials' teachers and professors. The bottom line is that they are expected to behave in the same way as their parents only when they start working. In the workplace, once they make big mistakes, they get fired, and are not praised only for showing up. They are not encouraged and guided anymore, and they become disillusioned.

In spite of that, parents continue to be extremely involved in their Millennial children's careers and lives (and the case is mostly the opposite with previous generations), and many HR managers consider it a secret weapon to talk to or involve parents in some way in order to convince the Millennials to join or stay in a company. Several studies show that Millennials' parents are more influential than any other input. "Let's summarize these astounding statistics once more. Nearly nine out of ten (88 percent) of the Millennials look to their parents as a positive influence, and only 3 percent view the parents negatively. Also, 85 percent of the Millennials look to their parents as their primary source of advice and guidance." And here's the irony- Baby Boomer and Xers complain the most about Millennials and they do not realize they are products of their own parenting style.

3. MILLENNIALS AS DIGITAL NATIVES

Millennials are the first generation born after computers and technology have been invented. They are part and parcel of their lives, just like the radio or TV was of previous generation. They are called digital natives because they are native speakers of the digital language of computers, the Internet and other virtual reality media. That's why their attitude towards it is significantly different from that of digital immigrants who have only partially adopted technology as part of their work and life. Millennials, called by some Generation Txt, are always connected, either by email, smartphones or social networking sites, and they always communicate. They want this kind of communication in their workplace as well, they are used to it and feel more comfortable with than with face-to-face communication. They also want access to anyone and anything at any time. 'Just as access to any information is taken for granted, so is access to anybody' (Caraher, 2015). In addition, their informality present in virtual world, is usually transmitted to the workplace, where, accompanied with the crave for an unrestricted accessibility, makes this generation blind to hierarchy.

Apart from being always available as well as connected to everyone, digital world has also conditioned them to fast responses depriving them of patience (once an extremely valued characteristic). Now they want immediacy at work as well as in their private lives.
Blogging and gaming on the Internet, chatting on social networking sites, made them prone to team work, diverse surrounding and peer collaboration both in real and virtual world, since they simultaneously live in both. Due to the virtual world they prefer an interactive, engaging and fun environment, including the workplace as well.

The Generation Y is defined by uncertainty, uncertainty of their safety, uncertainty of their future, and uncertainty of what is to come next. Terrorism, global economic crisis, recession, lay-offs have been their reality emphasizing the unpredictability of tomorrow. The only sure thing about the future of the Millennials is that everything can change, and that the change is the only predictable thing in their lives. And they have trained themselves to expect it. The whole concept of their career perspective has changed in comparison to the one of the former generations. Lifelong learning, perpetual professional development and acquisition of new skills have strengthen and equipped them for the time of the utmost uncertainty. They have learned how to rely on themselves rather than the institutions and not to have great expectations, but start from scratch easily every time the country or an institution lets them down. Moreover, they are not prone to making permanent connections with companies, but rather voluntarily change them in search for a better job which will give them more satisfaction on a daily basis.

The advance of technology, rapid communication and transportation, has made the world a 'global village'. Relationships are built via social networks, and video conferencing has allowed for the deepening of relationships among people who have not met in real life. Many companies are founded by partners whose relations are digital. The quality of somebody's work, not their geography, has become many headhunters' priority. Diverse workforce is becoming commonplace both in virtual and in real world. The awareness of global issues is also expanding. Meeting people virtually, travelling more internationally and connecting globally is what Millennials expect in their workplace as well, making diversity a must in their professional lives.

4. THE MILLENNIAL MIND-SET

In her book 'Millennials & Management: The Essential Guide to Making It Work at Work', Lee Caraher (2015) points out that contrary to how they are generally perceived by others, Millennials see themselves as confident, contributors, change makers and capable:

- Confident. They are confident that they can contribute, that they can learn, that they can make a difference, that they matter and that they can be fulfilled in their work as part of a meaningful life. On one hand, they are raised to believe in themselves, on the other hand, they don't want to spend their lives at miserable jobs just because they have to pay the rent, like some of their parents did or do. They want it all and they believe they can get it. There's just this problem that they want it now, sometimes with no hard work, hence the feeling of entitlement.
- Contributors. They want to contribute to the 'real' work from day one (which is why the direct access to leadership is at the top of the list of job satisfaction priorities for them). They want to do important work and do not want to wait for years to get an opportunity to do it. What is also connected to this is that hierarchy and structure of the company is an outdated concept for them, and something that stands in the way of their hopes, dreams and fulfillment. So, even though, according to Lee, 91% of Millennials expect to stay in their jobs for less than three years, they stay longer when they understand how they fit in, and how their work contributes. They want to feel that they are important for the company, and they want to be told so. They need feedback, support, and the thorough understanding of the entire work process of their company and how exactly they fit in and why their work and their job position is important.

- Change makers. They want and feel that they can make a difference (to change the world or their part of it), the way the business works, the way it contributes to the community (that's why their dedication to community service and volunteerism can be found in most of the researches on the topic). If their job makes a direct environmental or social change, they are more satisfied.
- Capable. They believe in themselves so much, that they can do anything, they feel they have so much to offer and that they are full of potential, and they question whether the job is right for them and not if they are right for the job (such a different attitude to that of Boomers or Xers at their age).

These Millennials' traits strongly influence the characteristics they desire from the workplace. The research conducted by Singh, Raj and Bhandaker (2012) and presented in their book 'Millennials and the Workplace: Challenges for Architecting the Organizations of Tomorrow' lists the following characteristics of the workplace as Millennials' priorities:

1. The Millennial generation craves for a work environment that provides its members with the freedom to experiment, offers opportunities for taking initiatives and encourages innovation and generating ideas.
2. The Millennial generation also wants to work in an environment where their work and contribution are recognized and rewarded.
3. Fairness and transparency are important factors that attract representatives of the Millennial generation to join the organization.
4. The members of the Millennial generation would like to work in the workplace which offers many opportunities for learning, growth and development.

Other important attributes of a desired job for Millennials are: the possibility of teamwork, frequent, constructive feedback, work-life balance, openness to suggestions and expressing opinions, opportunities for leadership development, participation in charity and volunteering, care for physical and mental health of the employees, and only after these come meeting their financial needs and job security.

5. CONCLUSION

In the past the workplace functioned in such a way that employees would simply follow orders given by the supervisor – they didn't ask questions. However, Millennials don't typically respond well to this type of management style. There is a big difference between what Generation Y expects and demands of a job and what it actually gets. In this regard, it is necessary to change the modern organizations and adjust them to meet the needs of Millennial workers which will soon dominate the workplace in numbers. Modern workplaces have become more flexible and respectful of the needs of their employees. The most important segments of management to work on while building a Millennial-friendly organization include: making work meaningful, giving clear directions, providing constant feedback, provide meaningful acknowledgement and appreciation, ensuring transparency, providing full-life approach to work, providing access to management/leadership as well as mutual mentorship.

REFERENCES

Barkin, S. L., Heerman, W. J., Warren, M. D., & Rennhoff, C. (2010). *Millennials and the world of work: The impact of obesity on health and productivity.* Journal of Business and Psychology, 25, 239-245.

Barnard, R. (1998). *Chips and Pop: Decoding the Nexus Generation.* Toronto: Malcom Lester, Canada.

Burke, R., Cooper, C.L., & Antoniou, A-S.G. (2015). *The Multi-generational and Aging Workforce: Challenges and Opportunities. Cheltenham*: Edward Eldgar Publishing Limited, UK.

Caraher, L. (2015*). Millennials & Management: The Essential Guide to Making It Work at Work,* Brookline: Biblimotion, Inc., USA.

Deal, J. J., Altman, D. G., & Rogelberg, S. G. (2010). *Millennials at work: What we know and what we need to do (if anything).* Journal of Business and Psychology, 25, 191-199.

De Hauw, S., & De Vos, A. (2010). *Millennials' career perspective and psychological contract expectations: Does the recession lead to lowered expectations?.* Journal of Business and Psychology, 25, 293-302.

Inglehart, R. (1997). *Modarnization and Postmodarnization: Cultural, Economic, and Political Change in 43 Societies.* Princeton: Princeton University Press, New Jersey.

Singh, P., Raj, S., & Bhandaker, A. (2012*). Millennials and the Workplace : Challenges for Architecting the Organizations of Tomorrow*. New Delhi: SAGE Publications India Pvt., Ltd., India.

Shaputis, K. (2004). *The Crowded Nest Syndrome: Surviving the Return of Adult Children*. Olympia: Clutter Fairy Publishing, USA.

Tulgan, B. (2015). *Bridging the Soft Skills Gap: How to Teach the Missing Basics to Today's Young Talent*. New Jersey: John Wiley & Sons, Inc., Hoboken, NJ.

Zemke, R., Raines, C., & Filipczak, B. (2013). *Generations at Work: Managing the Clash of Boomers, Gen Xers, and Gen Yers in the Workplace* (2nd ed.). New York: AMACOM, USA.

WHAT EVER HAPPENED TO THE CONCEPT OF HR BUSINESS PARTNERSHIP? SOME EVIDENCE ON FIRMS OPERATING IN SERBIA

Ivan Stefanović[1]
[1]Business Processes and Procedures Department Head, Vojvodjanska Bank ad Novi Sad
e-mail: ivan.stefanovic@voban.groupnbg.com

Abstract: *The concept of HR business partnership has not been understood appropriately by the majority of HR professionals in Serbia, which is why this paper seeks to remedy this situation. It starts with a theoretical concept of HR business partnership and accompanying Ulrich's model. After that, some insights about the current situation of HR business partnership concept in Serbia are given based on the author's investigation within three firms operating in different industries. In the end, a set of guidelines for HR professionals is provided. They refer to the need of acquiring better understanding of the HR business partnership concepts and Ulrich's model, after which they provide several useful steps for implanting them within a firm. The premise of the whole paper is that, if HR professionals want to take a sit at the executive table, they have to position themselves as strategic partners that add value to the entire organization.*

Keywords*: HR, business partnership, Ulrich's model, HR excellence, HR service center*

1. INTRODUCTION

Some critics argue that HR has not yet proved to be worthy to take this place because it acts more as an administrative service or compliance function than business partner (Ulrich & Dulebohn, 2015). Even some critics in US, where the field of HR has its roots, say that HR managers focus too much on administrative side of their work and lack vision and strategic insight (Cappelli, 2015). They claim that HR function is more focused on details within its scope of authority than the big picture and it is more concerned with its specific activities than the end-to-end value creation for the external customer. In other words, there is too much concentration on being expert in particular areas, such as: recruitment, staffing, rewarding, communication, training, employee relations, and so on (Hird, Marsh & Sparrow, 2009). What is needed instead is orientation on results and overall firm performance.

The concept built during 1990s as a result of inability of HR to make a significant contribution to the strategic agenda came to be known as "HR Business Partnership" (Ulrich et al., 1995; Ulrich, 1997; Losey, 1999; Ramlall, 2006). Intent of the HR Business Partnership (HRBP) was to help HR professionals integrate more thoroughly into business processes and align their day-to-day work with business outcomes (Ulrich & Brockbank 2009). With this concept, HR professionals have tried to provide a seemingly profound answer to the challenges business has been imposing on them. Even though HRBP has resulted in increasing the perceived value of HR, it is still hard to say whether it is close to deliver value to the business on a constant basis as promised.

2. THEORETICAL BACKGROUND

HRBP concept has not evolved over night, but rather resulted as a response to the shifting demands of business through the years of HR discipline development. Therefore, a very short look back down the HR history lane seems to be appropriate, after which we will explaine the model that enables HRBP concept operationalization.

2.1. A Short Look Back at the HR History

The need for HR and the emergence of this field as a profession in U.S. were results of World War I. In 1914 a widespread labor shortage began, especially for skilled workers, resulting in wage increases. This situation created a need for employers to utilize their workforce as much efficiently as possible, while trying to minimize the turnover rate. The epilogue was seen in establishing personnel departments between 1915 and 1920 to centralize employment related activities directed toward meeting business needs (Ulrich & Dulebohn, 2015).

In the following period, the priority of HR has been on dealing with unions due to their growth in power, while most other activities came to be viewed as low level and purely transactional. Thus, business has started to perceive HR as a necessary function that focused on administrative activities and cost control.

Another leap in viewing HR as a function that adds value to the entire organization happened in 1980s. This happened due to several factors occurring simultaneously: increased internationalization of business operations, deregulation in many industries, decreased unionization, changes in employment legislation, and the start of the shift from industrial to knowledge-based economy (Ulrich & Dulebohn, 2015). This situation led to rethinking the way in which business perceived its employees. All the sudden, they were no longer treated as mere expense, but became the most valued "resource" for gaining advantage over competitors (Prewitt, 1982). This approach was based on so-called "inside-out" view (Baden-Fuller & Stopford, 1994), in which internal resources constitute the starting point for understanding what organizational success means.

The massive restructuring of firms that took place in subsequent years starting from the 1990s, saw the first large scale outsourcing, including a large portion of transactional HR activities, such as payroll and benefits processing, as well as some types of training. At the same time, information technology proliferation has enabled the use of employee self-service with respect to a wide variety of HR activities. All the sudden, it has become obvious that a radical shift in perception of HR has to happen again in order for HR field and profession to remain viable in the long run.

2.2. The Contemporary HR Paradigm

Pressed with increasing demand to produce more value to the bottom-line, HR professionals had to rethink its role within a firm. The line of work that sparked the new wave of thinking about HR has been provided by various authors who argued that overall firm performance is maximized when HR policies and practices are consistent with the business strategy (cf. Schuler & Jackson, 1987; Miles and Snow, 1984, Ulrich, 1997, Becker and Huselid, 1998). In the exact words of Lawler and Mohrman (2003): "HR's greatest opportunity to add value may well be to play a role in the development and implementation of corporate strategy." (p. 2) This wave led to HRBP concept in the form we know today.

HRBP concept focuses on HR's role in the creation and maintenance of the capabilities that a firm must possess in order to deliver value to its customers, shareholders, employees and communities (Ulrich & Brockbank 2009). In order to be viable in everyday life of a firm, HRBP work ought to be divided into at least three, but in more complex organizations – five components, each with its own roles and responsibilities (Joinson, 1999; Kates, 2006; Ulrich, Younger & Brockbank, 2008; Ulrich & Dulebohn, 2015). Three basic components and their interactions came to be known as "Ulrich model", "3 Box model" or "Three Legged Stool". These components are as follows:

(1) HR business partners (a customer-facing front end). These are generalists who are matrixed in some form between line managers and HR. They act as consultants and planners, linking the business with appropriate HR programs. In other words, they are client relations managers whose job it is to diagnose client's wants and needs and then pull knowledge together to meet those client's expectations.
(2) Centers of excellence/knowledge (a product-focused back end). These are small specialist groups that produce programs and policies and provide decision support. They are populated with individuals who have deep expertise in the HR core areas of staffing, learning, compensation, organization development, and so forth. These employees depend upon the business partners to roll out the programs they create to the business.
(3) Operational/administrative service center. This center is intended to reduce costs and improve both efficiency and quality by systematizing and reducing transactional work, such as: payroll and benefits processing, employee assistance programs, relocation administration, pension plan enrollment and administration, applicant tracking, queries answering, resolving low-intensity employee relations issues, and the like. In addition, by taking employee-centered work away from the generalists, it theoretically frees up their time to concentrate on higher-value, management-focused work. HR service center enjoys economies of scale, meeting employee needs and resolving concerns by fewer dedicated HR resources based on highly standardized processes. Due to maturation of information technology, it may be located anywhere (usually, the choice is some lower-cost location, such as Eastern Europe or India). Also, the center may be centralized internally, outsourced, or provided through multiple vendors.

Even though the model just depicted proved to be worthy in terms of adding value to the overall business, some HR work continued to fall through the cracks (Reilly & Williams, 2006). Thus, the work on

operationalizing HRBP had to be continued. Besides these three basic components, two additional components were brought to light in order to strengthen the weaknesses perceived in the "Three Legged Stool" model (Ulrich, Younger & Brockbank, 2008). These are:

(4) Operational executor. What has been missing in some HR endeavours is the capacity to deliver and implement the ideas from the excellence center, while maintaining focus on the business and its customers. While this work ideally occurs through an integrated team made from experts pulled from various components of the excellence center, a designated person ought to be charged with this team and how it works. Thus, operational executor is usually assigned to a business in order to help turn the strategy into action. This position is focused on implementing specific projects within the business.
(5) Corporate HR. Since operationalization of HRBP concept obviously disperses HR activities, it is necessary to have one instance to integrate the remaining four. Therefore, corporate HR is established. Its primary concerns are the relations with CEO and the rest of top management, alignment of all HR work to be done with business goals, arbitration of disputes between centers of excellence and business partners, ensuring HR professional development and creating a consistent organizational culture.

As Ulrich's HRBP model has grown in popularity, numerous questions have been raised. For example: (1) Is this model suitable for firms no matter what their context or industry is, (2) What specific competencies does each role require, (3) how should differentiated roles be integrated in order to achieve the necessary level of coordination, (4) is this model really effective in selecting and developing business partners or linking HR strategy and business strategy, etc. Some of these questions have been answered and others are still waiting for appropriate response based on empirical evidence.

However, the fact remains that the benefits gained from Ulrich's model implementation have been mixed. While HR in some firms has made progress down the road of becoming a true business partner, many other firms claimed not to be able to experience the results anticipated by the use of this model. It has become obvious that the depth of HR talent capable of taking on an HR business partner role varies markedly between countries and firms. On the other hand, cultural differences reflected in the relationship between line managers and employees, and employees and HR have all impacted the ease with which this model can be implemented.

The results of a year-long ethnographic study considering the themes of becoming strategic, becoming a partner and remaining a generalist, showed that various tensions emerge as HR practitioners attempt to become strategic partners (Pritchard, 2010). Caldwell (2003) argues that converting HR practitioners to strategic partners will always be an overly ambitious transformation given the intrinsic role of ambiguities in the HR profession, which derived from its shifting cross-functional boundaries, substitutable expertise, unclear accountabilities and performance measures, and invariably problematic dependence on line managers for HR delivery (Caldwell, 2003).

Nevertheless, HRBP concept and Ulrich's model have proven their usefulness in different contexts, especially in firms with product portfolio diversified in related, as well as in non-related manner (Ulrich, Younger & Brockbank, 2008).

3. HR BUSINESS PARTNERSHIP CONCEPT IN FIRMS OPERATING IN SERBIA

The critique presented by magazine Fast Company's deputy editor, Keith Hammonds, in August 2005 has brought to light many negative aspects of HR work (Hammond, 2005). Hammond argued that HR managers contributed very little to organizational performance and remained fixated to bureaucratic procedures and administrative tasks. He also noted that the few things HR was good at could be outsourced, and that the strategic contribution HR managers were trying to achieve was beyond their capabilities. As much harsh as this critique may sound, it perfectly paints the picture of HR work in majority of firms operating in Serbia today, 10 years after this article was published.

Even though there is a general agreement that: (1) human capital can be a source of competitive advantage, (2) HR practices have the most direct influence of human capital of a firm, and (3) the complex nature of HRM systems of practice can enhance the inimitability of the firm (Delerey and Shaw, 2001), there is still an urge to thoroughly define how HR is going to add value to the firm and enhance its overall performance. This is especially true for firms doing business in Serbia. In those firms, it seems that an "inside-out" approach (Baden-Fuller & Stopford, 1994) still dominates. Under this approach, HR creates value just by serving employees, redesigning HR practices or making them more efficient.

So what ever happened to the HRBP concept in Serbia? The simplest answer would be that it has been misunderstood by majority of firms that attempted to implement it. This conclusion is made based on more than dozen unstructured interviews in the previous four years author has had with HR representatives working in various industries. However, since information gathered this way is not first-hand, i.e. not experienced directly, it has been treated only as a spark for further investigation on this topic. As a result, three large firms operating in Serbia, each of them with a long tradition but within different industries, were chosen for examination of HR practices. Their names will not be revealed due to confidentiality reasons.

3.1. Chemical Exporter

The first firm operates in chemical industry. It was founded in 1970s and now employs more than 1,500 people. Even though its technology is very old and needs to be renewed, it has a wide range of products with more than two-thirds of revenues coming from the export.

As for the HR concerns, it does not have a business partnership concept implemented. Instead, it relies on classic functional support to the business based mainly on transactional activities, which is the result of several factors (analysis of these factors is out of scope of this paper and will not be discussed any further). In other words, the work is more focused on administrative tasks, rather than on talent issues. Nevertheless, HR is divided in the following areas of expertise: recruitment and staffing, training and development, administration, employee relations, and internal communications. These areas of expertise are being coordinated at the level of HR director. This person is responsible for integrating the efforts of HR employees and delivering services to the business. The following figure illustrates the relations between HR and business (Figure 1).

Nevertheless, even a highly capable HR director cannot replace the business partnership concept, no matter how hard he or she tries. In the case of the Chemical Exporter, HR is acting completely reactively. It is mainly focused on administrative and employee relations tasks, while often seeks outside help from various consultants for HR activities that may influence the strategic agenda of the firm. Even though there is awareness about the lack of HR competences, nothing is being done in order to develop the knowledge, skills and abilities that might help the business to achieve its goals and add value to the organizational performances.

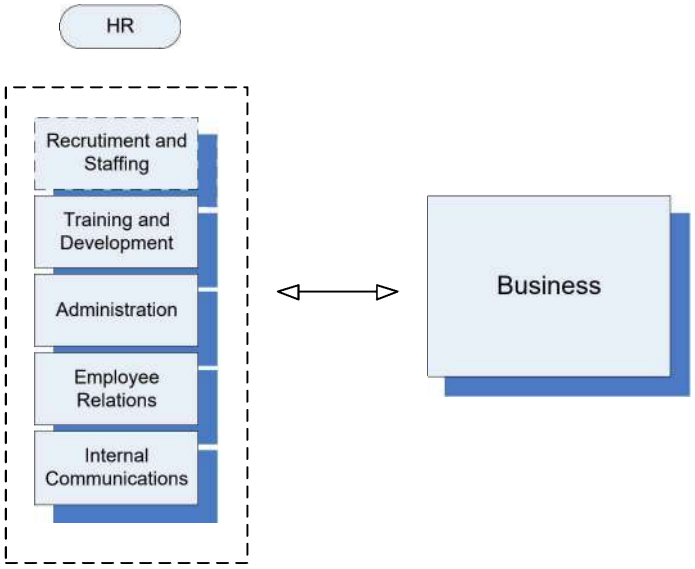


Figure 1: Relationship between HR and business in Chemical Exporter

3.2. Financial Traditionalist

The second firm operates in financial industry. It was established in 1860s with the aim of providing loans to the farmers. In the following decades, it has significantly broadened its scope of services resulting in a complete strategic repositioning. These changes in its business policy, even though seem large when perceived cumulatively, have been made in a slow and conservative fashion during a long time period. On the other hand, exceptionally long history of this firm has allowed it to play a very important role in the

development of Serbian economy, thus creating its image in a public as a very reliable business partner with traditionalist values. It now provides jobs to approximately 1,500 people.

In this firm, HR has recognized the concept of business partnership as a valuable asset and started its implementation. Nevertheless, the model currently implemented represents some sort of a hybrid somewhere between functional and HRBP models. As may be seen in Figure 2, HR Business Partner is actually a liaison between business on one side, and recruitment and staffing, as well as training and development on the other. In other words, if the business needs some services related to internal or external staffing, or perhaps increasing the competences of employees, it will approach HR Business Partner. On the other hand, services related to employee administration or relations, job descriptions, internal communication, and so on, will be provided directly, without HR Business Partner in between.

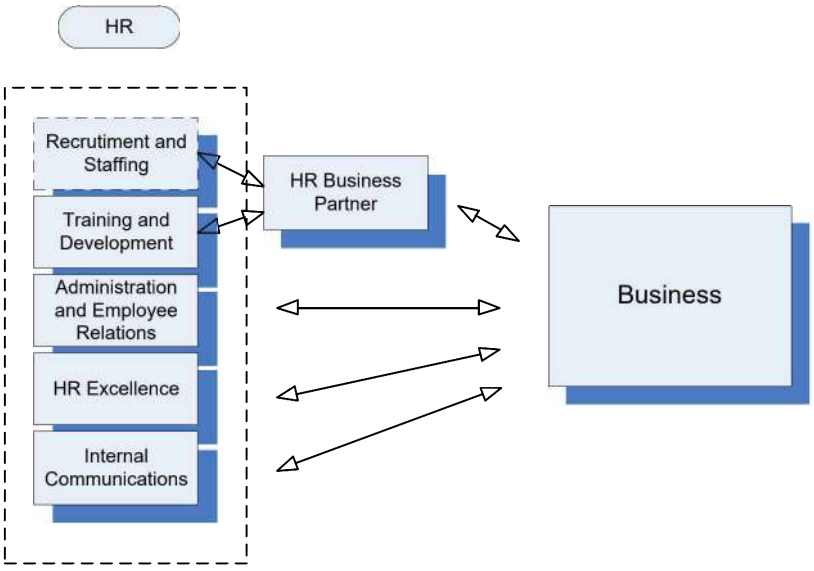


Figure 2: Relationship between HR and business in Financial Traditionalist

Even though HR Business Partner role in this case somewhat decreases the complexity for the business by creating a single point of contact for staffing and development services, it does not add true value to the strategic agenda. HR is still acting reactively by providing mainly transactional services on demand (even talent management services, if done purely according to the request when requested, may be seen as transactional), mainly due to the fact that there is still a wide gap to bridge in terms of competences needed to become a value added business partner.

3.3. Oil Major

The third firm operates in oil and gas industry. It was founded in 1940s in order to perform oil and oil derivatives trading. Due to its long history, it has gone through several periods of profound ownership and organizational restructurings, resulting in significant growth and business development. Now, it has become a vertically integrated firm with various products, supplying a major part of Serbian oil market. It has also become a highly successful competitor in the regional market that employs more than 10,000 people and provides a significant contribution to the Serbian GDP and budget increase.

Oil Major is organized into several divisions, each one being semi-autonomous and in charge for one particular part of the integrated value chain. Due to the complexity of the business coming from several lines of operations, it had been decided that HR needs would have been best served by adopting the HRBP concept. Therefore, each division has been granted a designated HR Business Partner in charge for all of its HR challenges. At the same time, administrative tasks have been kept centralized. They have been automated and organized based on a self-service principle. The HRBP model implemented in this firm is depicted in Figure 3,

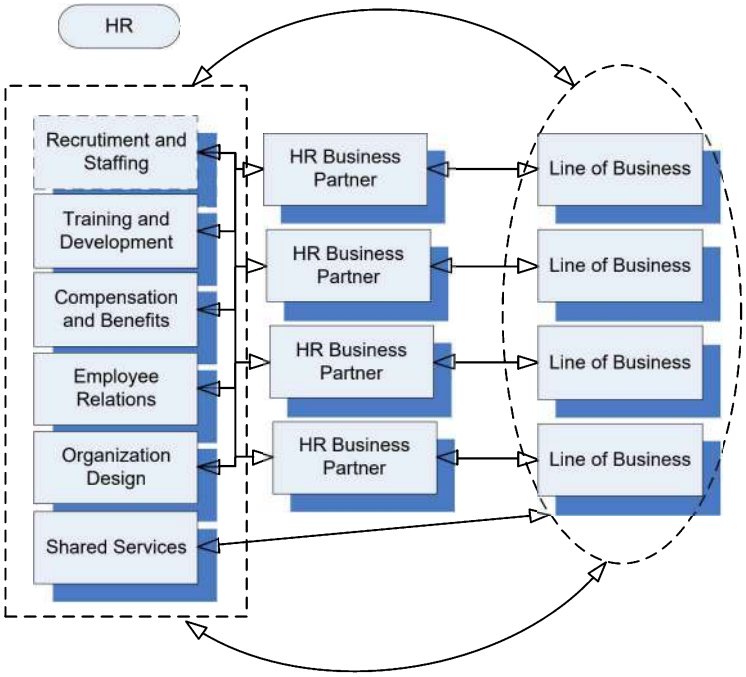


Figure 3: Relationship between HR and business in Oil Major

However, due to the lack of a proper communication about the business partnership concept and critical competences needed for this model to be adopted throughout the firm, as well as a strong organizational heritage that created inertia, the result of the entire endeavour has not been a true HRBP model. Rather, it has been a sort of a hybrid that, on one hand, provides the interface for all HR services toward the lines of business in the form of a designated HR Business Partner. Here, a business partner is an HR generalist and acts as a broker by providing the services to the business that he or she integrates after pulling them from HR centers of knowledge (Recruitments and Staffing, Training and Development, Organization Design, etc). On the other hand, the relationships between the business lines and HR centers of knowledge are still being maintained, which very often results in HR Business Partners being skipped. In those cases, business lines communicate with HR lines directly.

This situation creates a lot of difficulties and confusion. Roles are not well defined, activities are being duplicated, and communication channels are not straightforward. This usually leads to procedure breaches, not meeting the deadlines and overhead costs increase. Thus, implementation of this kind of HRPB model may have led this Oil Major into more unnecessary complexity, resulting in higher costs than benefits.

Regardless of the fact that some level of awareness about the importance of HRBP concept in Serbia does exist, after seeing these three examples, one might conclude that the attempts of implementing it somehow do not achieve the desired end result. Even though findings in these three organizations certainly may not be generalized on the whole population of firms operating in Serbia, they may serve as a signal that the HRBP concept has not been understood correctly in the HR community and that it is necessary to remedy this situation. Therefore, some recommendations seem appropriate.

4. RECOMMENDATIONS FOR HR PROFESSIONALS IN SERBIA

If firms operating in Serbia want to increase the value they add to the business, their perception of the business ought to switch. Instead of “inside-out”, they need to adopt an “outside-in” view. This approach starts with the environment in which the firm operates, after that it moves to the strategy by which the firm seeks its alignment with the environment, and finally considers HR policies and practices customized to meet the strategy and add value to it. According to Ulrich and Dulebohn (2015), in “outside-in” approach, HR creates value by making sure that services HR offers inside the firm are aligned to expectations outside the firm. Therefore, HR professionals ought to “… shift their attention from the organizational level and internal regulation to a more interactive level between the organization and the environment…” (Paauwe & Boselie, 2003, p. 67)

So, what is needed in order for HR in firms operating in Serbia to become a strategic partner? It seems that the proposal provided by Lawler and Mohrman (2003) for the firms operating in developed country equally applies to the situation currently found in Serbia. "The consensus seems to be that change is required both in the skills of individuals in the HR function and the way the HR function is organized and carries out its activities. HR not only needs to have competencies having to do with the business issues involved in strategy and strategy development, it needs to be able to contribute to organization design and change management. As far as its own organization concerns, it needs to be organized to carry out the basic administrative functions as well as being a strategic partner." (Lawler & Mohrman, 2003, pp. 4-5)

If this becomes a case, the business will finally start perceiving HR as a true strategic partner. According to Ulrich, Brockbank & Johnson (2009), HR professionals can ensure HR takes a true leap toward becoming a strategic partner by doing the following:

(1) Facilitate the strategy creation process by ensuring that right people are engaged in communication about strategic agenda and streamlining this discussion.
(2) Help clarify and articulate the strategy by making substantive contribution in communicating strategy to all employees and other stakeholders.
(3) Ensure execution of strategy by aligning HR practices in all its activities (recruitment, staffing, rewarding, communication, training, etc).
(4) Align leadership behaviour to strategy by clearly articulating what leadership knowledge and behaviours align with strategy and then turning these expectations into clear competencies and performance standards.
(5) Bring the view of the outside customer in by getting to know the motives, drives, and needs of external customers, and then translating this knowledge into relevant actions.

It should be mentioned that, in practice, the implementation of HRBP has rarely followed a single model, and there is growing concern regarding the efficacy of the more generic and context-independent competency frameworks propounded by advocates of business partnering (Ulrich and Brockbank, 2005). In other words, HR professionals in Serbia must undertake a broad multidimensional analysis of the current situation in their firms. Only after they are fully aware of the strengths and weaknesses within them, they may start designing the HRBP model to be implemented, as well as the process of implementation. The contingency approach should be entirely taken into account (cf. Pugh et al, 1963; Lawrence and Lorsch, 1967; Mintzberg, 1979).

5. CONCLUSION

HRBP concept and accompanying Ulrich's model have presented a tremendous revelation within the field of HR development. They have paved the way toward increased significance of HR as a true business partner that influences the performance of an entire firm.

Nevertheless, experience in Serbia has shown that implementation of HRBP concept is not an easy task to master. HR professionals must understand what this concept is really about and start working on elevating their competences in order to meet the requirements of becoming strategic partners. On the other hand, simply pursuing the structural solution implied by the Ulrich's model is not a sufficient condition for HR to deliver high perceived value (cf. Hird, Marsh & Sparrow, 2009). Becoming true strategic partners that add value to the entire organization require from HR professionals to understand the business context and key stakeholders, as well as how they interact with each other. They also need to rethink their role within the firm and find a way in which they may add value to the entire firm. These findings will help them acquire the knowledge that will enable them to participate in strategy formulation and execution on a sustainable basis.

HR has traveled a long way since it first emerged as a profession, but it seems that somewhere down the road it took a wrong turn, especially in case of Serbia. In order to continue this journey toward increasing the significance of HR as a true business partner, HR professionals must rethink their purpose and role in firms and start developing HR as a contributor of value to the strategic agenda. They must embrace the fact that if they wish to be recognized and take a sit at the executive table, they will have to be able to bring their share of value to the performance of an entire organization.

REFERENCES

Baden-Fuller, C. & Stopford, J. M. (1994). Creating Corporate Entrepreneurship. Strategic Management Journal, 15(7), 521-536.

Becker, B. E. & Huselid, M. A. (1998). High Performance Work Systems and Firm Performance: A Synthesis of Research and Managerial Implications. Research in Personnel and Human Resource Management, 16, 53-101.

Cappelli, P. (2015). Why We Love to Hate HR… and What HR Can Do About It. Harvard Business Review, July-August, 54-61.
Cascio, W. F. (2005). From Business Partner to Driving Business Success: The Next Step in the Evolution of HR Management. Human Resource Management, 44(2), 159-163.
Caldwell, R. (2003). The Changing Roles of Personnel Managers: Old Ambiguities, New Uncertainties. Journal of Management Studies, 40(4), 983–1004.
Delerey, J. E. & Shaw, J. D. (2001). The Strategic Management of People in Work Organizations: Review, Synthesis and Extension. Research in Personnel and Human Resources Management, 20, 165-197.
Hammonds, K. H. (2005). Why We Hate HR? Fast Company, 97, 40-47.
Hird, M., Marsh C., & Sparrow, P. (2009). HR Delivery Systems: Re-engineered or Over Engineered? CPHR White Paper 09/05, UK: Lancaster University Management School.
Joinson, C. (1999). Changing Shapes: Trends in Human Resource Reorganisations. HR Magazine, March, 40-45.
Kates, A. (2006). (Re)Designing the HR Organization. Human Resource Planning, 29(2), 22-30.
Lawler, E. E. III & Mohrman, S. A. (2003). HR as a Strategic Partner: What Does It Take to Make It Happen? Los Angeles, CA: Center for Effective Organizations, Marshall School of Business.
Lawrence, P. & Lorsch, J. (1967). Organization and Environment: Managing Differentiation and Integration. Boston, MA: Graduate School of Business Administration, Harvard University.
Losey, M. (1999). Mastering the Competencies of HR Management. Human Resource Management, 38(2), 99–103.
Miles, R. & Snow, C. (1984). Designing Strategic Human Resources System. Organizational Dynamics, Summer, 36-52.
Mintzberg, H. (1979). The Structuring of Organizations. Englewood Cliffs, NJ: Prentice-Hall.
Paauwe, J. & Boselie, P. (2003). Challenging "Strategic HRM" and the Relevance of the Institutional Setting. Human Resource Management Journal, 13(3), 56-70.
Prewitt, L. B. (1982). The Emerging Field of Human Resources Management. The Personnel Administrator, 27(5), 81–87.
Pritchard, K. (2010). Becoming an HR Strategic Partner: Tales of Transition. Human Resource Management Journal, 20(2), 175-188.
Pugh, D. S., Hickson, D. J., Hinings, C. R., Macdonald, K. M., Turner, C., & Lupton, T. (1963). A Conceptual Scheme for Organizational Analysis. Administrative Science Quarterly, 8, 289-315.
Ramlall, S. J. (2006). Identifying and Understanding HR Competencies and Their Relationship to Organisational Practices. Applied HRM Research, 11(1), 27–38.
Reilly, P. & Williams, T. (2006). Strategic HR: Building the Capability to Deliver. London: Gower Publishing.
Schuler, R. & Jackson, S. (1987). Linking Competitive Strategies and Human Resource Management Practice. Academy of Management Executive, 1(3), 207-209.
Ulrich, D. (1997). Human Resources Champions. Boston, MA: Harvard Business School Press.
Ulrich, D. & Brockbank, W. (2005). The HR Value Proposition. Boston, MA: Harvard University Press.
Ulrich, D. & Brockbank, W. (2009). The Business Partner Model: Past and Future Perspective. TMTC Journal of Management, July, 24-32.
Ulrich, D., Brockbank, W., & Johnson, D. (2009). The Role of the Strategy Architect in the Strategic HR Organization. TMTC Journal of Management, July, 12-23.
Ulrich, D., Brockbank, W., Yeung, A., & Lake, D. (1995). Human Resource Competencies: An Empirical Assessment. Human Resource Management, 34(4), 473–496.
Ulrich, D. & Dulebohn, J. H. (2015). Are We There Yet? What's Next for HR? Human Resource Management Review, 25, 188-204.
Ulrich, D., Younger, J., & Brockbank, W. (2008). The Twenty-first-century HR Organization. Human Resource Management, Winter, 47(4), 829-850.

WFMS AS THE FOUNDATION OF BUSINESS PROCESS IMPROVEMENT: HUMAN RESOURCE MANAGEMENT PERSPECTIVE

Nemanja Minić[1], Marija Lukić[1], Milica Savić*[1]
[1] University of Belgrade, Faculty of organizational sciences
*Corresponding author, e-mail: savic1414@gmail.com

Abstract: *The optimization of business processes is a modern approach to implementation of organizational changes of different scope. This paper is closely related to business processes improvement through their automation and informatization. The aim of this paper is to explore the effects of the application of Omega Workflow Manager in the process of recruitment and selection of human resources. The basic characteristics of the process, its role in the organization, the impact on the efficiency and effectiveness are presented, as well as the description of an Omega Workflow Manager. The results of the analysis indicate that the implementation of this system leads to savings in terms of time, material resources and allows for a better control and coordination with the processes related to human resources.*

Keywords*: organizational change, process improvement, process optimization, workflow management, human resources*

1. INTRODUCTION

The term "process" may have various interpretations. Lindsay, Downs and Lunn (2003) cite the definition of Hammer and Champy from their well-known book *„Re-engineering the Corporation",* in which they define it as "a collection of activities that takes one or more kinds of input and creates an output that is of value to the customer. A business process has a goal and is affected by events occurring in the external world or in other processes" (p. 1015). Radović, Tomašević, Stojanović and Simeunović (2012) cite Davenport's definition of business processes as "a structured set of activities that can be measured, and which is designed to produce a specific output for a particular customer in the market" (p. 4). These definitions are sufficiently compressed, but at the same time they provide sufficient information to understand the processes and their importance.

Lin, Yang, and Pai (2002), after analyzing the work of well-known authors in this area like Davenport, Hammer, and Champy, suggest that business processes consist of five elements (p. 20-21):

- *Users* - each process serves a particular user with its output
- *Activities* - parts of the process which can be regarded as sub-processes
- *Related activities* – the identified activities are not isolated but are a part of the chain of activities directed towards the creation of value for the end user
- *People and technology* - the identified activities performed by humans or machines, or a combination thereof
- *Organizational units* - processes often span across multiple organizational units, but also there are processes that ocur in only one of them

Aguilar-Saven (2004) emphasizes that the processes go through different phases of development within an organization. These are (p. 131):

- The initial phase which leads to the establishment of the process
- The stage with an increasing number of repetitions of certain processes
- The defining phase that leads to the standardization and documentation of the process
- The stage where the processes can be managed, where you can measure and control their performance, and
- The optimization phase wherein the processes are being improved continuously

Hammer (2007) points out that for successful functioning, it is essential that the process is well designed and that the people who participate in its implementation have appropriate skills and knowledge. Furthermore, the owner of the process (a person who has authority and responsibility for providing the results of the process) needs to be identified and the infrastructure needs to support the progress of the process. Lastly, it is necessary for the system measuring the process results to be precisely developed. All these elements correlate with each other and they cannot separately lead to the proper operation of the process. Although all these elements are prerequisite and obligatory, the existence of each one of them is no guarantee for the progress of the process. In addition, so as to successfully realize the process, the existence of certain

organizational elements is critical. The most significant among them are leadership, culture, expertise, and management (p. 3).
When the process does not work properly, the certain changes must be taken. Draheim (2010, p. 16-17) and Mansar and Reijers (2007, p. 199) suggest that improvements of the process can be achieved in different ways: by defining a new job by combining several existing ones (elimination, recombination or introduction of new activities), performing work in the context where it arises, balancing centralization versus decentralization, allowing decision making at the operational level, allowing process steps to be performed parallelly wherever possible, identifying efficient versions of business processes, reducing control etc. These activities are performed in order to achive the process standardization. As Davenport (2005) points out, this term may refer to the standardization of activities and the process flow, standardization of process performance (when companies determine the activities that make up a process, they can start measuring its results and comparing it with external companies), standardization of process management (which shows how well the processes are managed and how to measure their success). This type of standardization is now the most widely used (p. 102-104).

There are various types of business processes; however, taking into account the aim of this paper we will highlight Porter's (2008) classification of activities: *primary activities* (inbound logistics, operations, outbound logistics, marketing & sales, and service) and *support activities* (firm infrastructure, human resource management, technology development and procurement) (p. 37). The following sections of this paper shall focus on dealing with the support processes, since their automation is rather applicable.

Once we have identified the basic elements and main characteristics of business processes, we shall analyze the concept of automation and informatization of business processes, as well as *Omega Workflow Manager*.

2. WORKFLOW MANAGEMENT SYSTEMS (WFMS)

Informatization and automation of business processes create the opportunity for "consideration of the organization on the entirely new way" (Jaško, Čudanov, Jevtić, & Krivokapić, 2013, p. 34). Permanent development of information and communication technologies on a global scale has caused an expansive growth of automation and informatization of business processes. Enterprise Resource Planning (ERP) and Workflow Management System (WfMS) are some of the most commonly used software solutions that represent the integration of IT-domain and business process management (BPM). Ravesteyn and Batenburg (2010) point out that implementation of such a solution is very often understood as "just another software application" and from this perspective it usually leads to a lack of coordination with social and organizational aspects of business (p. 493). Therefore, to prevent this kind of business misunderstanding, they suggest that "...organizations should realize that BPM-system implementation is not mainly an IT project, but should preferably be initiated by top management" (Ravesteyn & Batenburg, 2010, p. 492).

Petković and Lazarević (2012) define the workflow management as "…a technological support in redesigning work, business and information processes, as a technique of organizational change and a technique of process redesign" (p. 60). Also, Mentzas, Halaris and Kavadias (2001) describe the workflow management system as "…the most evolved of those applications providing consistent information flow between the participants in the process, smooth integration of the flow of work, timely sharing of data and information during the planning and implementation phases and harmonious support for the collaborative aspects of work" (p. 124). They highlight that development and implementation of this kind of application require precisely defined tasks, employees' roles, rules, and procedures. WfMS, as a business processes management tool, has three main perspectives: (1) control flow perspective - defining the sequence of activities in the process; (2) data perspective – the set of information that is transmitted, and (3) resource perspective - assigning responsibilities to employees for task realization (Stroppi, Chiotti, & Villarreal, 2015, p. 86).

Assigning a required number of people to carry out each business task, effective monitoring of its realization and control of the business task flow are the three main reasons why an increasing number of organizations all around the world have implemented WfMS (Tsai, Huang, Wang, & Chen, 2010, p. 1538). Besides that, WfMS allows employees to spend less time on delegation and coordination of work; process informatization leads to a decrease in time when a task comes to a standstill during its life cycle and also encourages the reduction of time when task is to be completed (Reijers, Vanderfeesten, & Van der Aa, 2016, p. 128). For successful application of WfMS, it is necessary to precisely define the process - all steps and activities that the process comprises. A great number of authors emphasize the importance of properly defined process flow. For instance, Van der Aa, Reijers and Vanderfeesten (2016) explain that properly defining activities is

crucial because their content and size affect model understandability, experienced meaningfulness and execution efficiency, as three crucial aspects of process design (p.162).

Replacement of manual labour with a process that is automated through information system, leads to improvement of the process efficiency (Vukicevic & Milosevic, 2012, p. 65). Reijers, Vanderfeesten and Van der Aa (2016) did a multi-case longitudinal study of the implementation of Workflow Management System (WfMS) to determine whether the use of this kind of system positively affects the process improvement. This process oriented analysis included over 25 processes across 10 organizations and showed that the business process automation had a positive effect on reducing the time needed for the realization of business activities. The results showed that performance improvements through implementation of WfMS in general were substantial (p. 130-139).

Based on the literature review, we can conclude that the WfMS is a modern, applicable and prospective concept, which could lead to significant improvements, as shall be explored and demostrated in the case of *Omega Workflow Manage*r.

2.1. Omega Workflow Manager

Omega Work Flow Manager is a web application created using a variety of Internet technologies in order to develop a software that will support process automation of the real system (organization). The authors have attempted to make this application user-friendly, so that the software can be quickly developed and implemented. A wide range of functionalities allow modeling of mainly medium-sized processes.

The software is based on logic and the basic elements of the existing process, as well as on the experience of WFM moderator. WFM primarily has been developed for moderators of the process, i.e. people who are studying, modeling and designing process to create software. Also, predefined processes help automation of new similar processes, which is great because clients require a simple and quick solution.

The form that represents the process has its own database – information, users, execution rules, restrictions, etc. It is divided into steps and each step has its own processor. The processor is actually the owner of the step. The step represents an ordered set of pages, wherein questions for the users are defined, recognized and adequately set up in order to follow the process in the right way.

In OWfM, participants from the real process are presented as software users and activities are presented as steps. The application is able to communicate with the database, so it is possible to retrieve useful information which is not directly presented on the form, but could be useful in the decision-making process when a user starts filling out the form. As regards the work with data, SQL operations are supported (select, insert, update, delete), as well as queries and complex queries. All this is implemented through actions, which is comparable with methods in programming languages. With regard to the used technology, the outputs from the process (documents, reports and results) can be exported to an Excel or a Word file that allow monitoring of all data that have passed through OWfM, or, more precisely, through a certain process.

Process automation through OWfM is performed in several steps:
- Determination of processes which are to be automated
- Modeling business processes
- Defining users, their roles and activities
- Defining the database
- Defining the input and output documents

The graph below shows the use of certain software solutions depending on the complexity of the process. For example, an increase in the complexity reduces the efficiency of the use of e-mails as a tool of managing the process. Also, the more complex the process is, the ERP is imposed as the optimal solution, but the major obstacle is the price. Obviously, the implementation of OWfM in the processes of medium complexity is the best solution, provided that it is used in the right way.

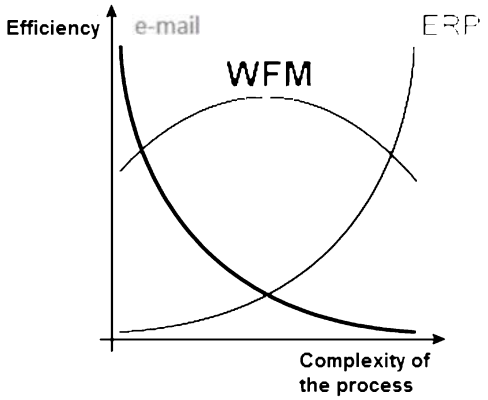


Figure 1: Relation between the process complexity and the software efficiency

These are the basic characteristics of Omega Workflow Manager. Moving on from the example of application in Organization M, we are going to present some of its implementation results, advantages, and limitations. The results of the following analysis are mainly quantitative, which is important for the comparison of the state before and after the introduction of OWfM.

3. THE EXAMPLE OF THE OMEGA WORKFLOW MANAGER IMPLEMENTATION

Organization M (hereinafter only *Organization*), measured by the number of employees (around 1,000) and financial performances, represents a large, successful and stable company. The organization does not have financial problems, but wants to improve the operational efficiency. The subject of the project was the improvement of HR processes, and the entire organizational unit (hereinafter only *Human Resources* or *HR*). Human resources consist of four departments: *Department for Norms of Labor Relations, Department for Employees Education and Training, Department for Labor Legal Affairs, and Department for Selection and Potentials Evaluation.* Each of these departments has employees in the central part of the organization, and in the four organizational depots. The analysis of the work volume in HR for the period of previous three years was conducted during the first phase of the project. The data on the main processes, their average duration as represented in hours, the number of repetitions on an annual basis, as well as the total annual work volume (average duration * number of repeats) for these organizational units and in total were obtained through the analysis and the relevant calculations. Some of the data are shown in the following table.

Table 1: List of HR processes, their annual duration and percentage share in total work volume

Process	Annual work volume (h)	Share in total work volume (%)
Department for Norms of Labor Relations	2,275	8.96%
Normatives of Labor Law Affairs	1,479	5.82%
Additional jobs	796	3.14%
Department for Employees Education and Training	8,059	31.74%
Employees education	1,633	6.43%
Training and professional development	2,839	11.18%
Additional jobs	3,588	14.13%
Department for Labor Legal Affairs	4,943	19.47%
Labor legal affairs during employment	3,519	13.86%
Labor legal affairs outside employment	172	0.68%
Labor legal affairs for employment	100	0.39%
Additional jobs	1,153	4.54%
Department for Selection and Potentials Evaluation	10,112	39.83%
Recruitment and selection of youth cooperatives	24	0.10%
Recruitment and selection for temporary jobs	415	1.63%
Recruitment and selection for intern	181	0.71%
Recruitment and selection of trainees	3,123	12.30%
Recruitment and selection for employment	5,280	20.80%
Additional jobs	1,091	4.30%
TOTAL	**25,390**	**100.00%**

It should be noted that not all of the business processes can be the subject of automation. For example, Hall and Johnson (2009) define so called "artistic processes" that use diversity environment to create variations of products or services that are highly valued by consumers (p. 58). These processes cannot be the subject of automation. Becker, Kugeler, and Rosemann (2003) suggest that the previous analysis should include structural characteristics of the process, organizational status and conditions, as well as the potential benefits of automation in order to allocate certain candidates (p. 268). Based on the results of the first phase, we can consider the type and the scope of work in human resources, and isolate the processes that can be modeled. This selection was based on the following criteria: the possibility of modeling, participation in total work volume, the possibility for the improvement of related processes in other organizational parts, and the number of participants in the process. In our case, the analysis showed that certain processes can be modeled (e.g. recruitment and selection, training and professional development, labor legal affairs), while others either cannot be modeled or are not so important for modeling (normative of labor law affairs and additional jobs by individual organizational units). For the purpose of this article, we will explain in detail modeling of the process of *Recruitment and selection*, while other processes were modeled in a similar way.

Recruitment and selection is one of the most important processes in organization M, as evidenced by the share of its organizational unit of 39.83% in total work volume. This can be seen as a direct consequence of the size of the organization and the constant need for new employees. There are several different forms of the process realization, depending on whether the subject is recruitment and selection for a full-time employment, for temporary jobs, for youth cooperatives or trainees. Essentially, the process encompasses the following activities: *initiation for declaration of needs for employees, identification of needs for employees, forming the Plan of employment, advertising the need for candidates, recruitment and selection of candidates, creation of the Employment Contract, and training on health and safety at work.* The process is carried out by three executors and passes through all previously mentioned services. The average number of repeats on an annual basis is around 1000 (including all different forms of recruitment and selection).

The process analysis revealed that there are some problems in the realization of most of these activities, and that there is a significant room for improvement. For example, during the activities of initiation for declaration of needs for employees, the identification of employees' needs, and forming the Plan of employment, there are problems of late delivery of the requested data, submission of data in a form that is not appropriate, unnecessary repetition of work (e.g. retyping the data) or frequent typing mistakes, and the like. These three activities are carried out for all of the above mentioned forms of recruitment and selection (full-time, temporary, youth cooperatives or trainees). In the part of advertising the needs for candidates and recruitment and selection of candidates, main problems are related to overworked (overburdened) employees at headquarters, since all received biographies are being analyzed in the central organizational unit, although in depots there are all the technical and human prerequisites for the performance of this activity, high costs of transport charges of candidates who are obliged to take all the selection tests in the central organizational unit, inefficient processing of received biographies in terms of their grouping in one place and inefficient comparison of one candidate with another. Then, in the part that refers to the creation *of the Employment Contract*, one of minor problems that may come up is that there are no document models that would be largely automatically filled, and therefore there is a possibility of making some minor mistakes. In relation to the abovementioned problems, this is the smallest one. Some common problems that exist in the whole process are related to the long duration that some routine tasks require, which results in a lack of time to deal with substantive matters; the fact that there is no process automation at all, and the data on employment are not integrated and available in one place. Thus, there is a large space for implementation of the system, not only for solving the current problems, but also for those that could arise in the future.

The implementation of the system was based on the previously presented analysis, the identification of the problems, and the needs of users. The largest portion of this phase was dedicated to a search for solutions to the identified problems, while the modeling was completed relatively quickly. Based on the analysis, it can be concluded that the long duration of the process is the main problem, or as a large part of it, and therefore, the focus was on its reduction. It should be noted that the system shortens the process duration in two basic ways: through the process optimization (e.g. elimination of unnecessary activities), and automation that the system allows (automatic creation of reports, documents, overview of the relevant data for the decision making, etc.). The improvements can be best examined by a comparative analysis of the obtained data presented in the table below. The table shows the situation before and after the system introduction.

Table 2: Comparative analysis of the process of recruitment and selection

Recruitment and selection	Duration time (before OWFM)	Duration time (after OWFM)	Change (%)
Initiation for declaration of needs for employees	5	3	40.00%
Identification of needs for employees	260	243	0.07%
Forming the Plan of employment	60	50	0.17%
Advertising the need for candidates	2.5	2.5	0.00%
Recruitment and selection of candidates	2	1	50.00%
Creation of the Employment Contract	5	3	40.00%
Training on health and safety at work	2	1	50.00%
TOTAL	**336.5**	**303.5**	**9.73%**

It is notable, based on the table, that a significant shortening of the duration of certain activities (from the minor ones by 0.07% to the large ones by 50.00%) has been achieved. This can be interpreted as a direct result of the transfer of particular manual activities to the system. What cannot be seen from the table is that the recruitment and selection activities were decentralized and partially transferred to depots, thereby achieving the savings in terms of the costs of transport charges. A very interesting fact is that this improvement was made without any other organizational change, which opens the space for redistribution of work within the framework of human resources, but also in relation to other organizational units (e.g. finance). Čudanov, Jaško, and Jevtić (2009), point out that "ICT itself does not point organization toward more or less decentralization, but widens possibilities for adjusting level of decentralization to other internal or external parameters characteristic to the organization. Development of ICT leaves much more freedom to the designers and consultants to accommodate organizations to other influences, both internal and external" (p. 106). Other processes in human resources were modeled in a similar way, and their obtained time savings are shown in the table below. By grouping the time reductions per processes and their organizational units, we made a comprehensive quantitative analysis of their improvements. Therefore, it can be noticed that the organizational unit of Human Resources achieved significant improvements in terms of time saving per organizational units (from 3.35% to 48.47%) and are huge in total. Besides these quantitative effects, there have been significant qualitative improvements, related to the main strenghts of the system listed in the following table.

Table 3: Effects of implementation of Omega Workflow Manager in HR

Process	Annual work volume (h)	Share in total work volume (%)	Annual work volume (h) after OWFM	Share in total work volume (%) after OWFM	Change after OWFM (%)
Department for Norms of Labor Relations	2,275	8.96%	2,199	12.20%	3.35%
Normatives of Labor Law Affairs	1,479	5.82%	1,479	8.21%	0.00%
Additional jobs	796	3.14%	769	4.27%	3.35%
Department for Employees Education and Training	8,059	31.74%	7,072	39.25%	12.25%
Employees education	1,633	6.43%	1,546	8.58%	5.33%
Training and professional development	2,839	11.18%	2,705	15.01%	4.71%
Additional jobs	3,588	14.13%	3,509	19.47%	2.21%
Department for Labor Legal Affairs	4,943	19.47%	3,537	19.63%	28.45%
Labor legal affairs during employment	3,519	13.86%	3,230	17.93%	8.21%
Labor legal affairs outside employment	172	0.68%	157	0.87%	8.57%
Labor legal affairs for employment	100	0.39%	92	0.51%	8.36%
Additional jobs	1,153	4.54%	1,115	6.19%	3.31%
Department for Selection and Potentials Evaluation	10,112	39.83%	5,211	28.92%	48.47%
Recruitment and selection of youth cooperatives	24	0.10%	22	0.12%	8.71%
Recruitment and selection for temporary jobs	415	1.63%	380	2.11%	8.36%
Recruitment and selection for intern	181	0.71%	165	0.91%	9.01%
Recruitment and selection of trainees	3,123	12.30%	2,834	15.73%	9.25%
Recruitment and selection for employment	5,280	20.80%	4,766	26.45%	9.73%
Additional jobs	1,091	4.30%	1,054	5.85%	3.41%
TOTAL	**25,390**	**100.00%**	**18,018**	**100.00%**	**92.52%**

The effects of the system implementation can be felt very quickly, especially for the processes which are often repeated. Having analyzed the improvements that the system has brought, we should shortly analyze the costs of implementation. In general, it can be said that they vary depending on the process complexity and the project duration (which again depends on the complexity), and that they are made of two components: the costs of process modeling, and the costs of license for using the software. The implementation costs can be roughly assessed at 40 Euros per hour, while the costs of license for using the

software could range from a few hundred Euros to several thousand Euros per month. However, as compared to other, more complicated softwares (e.g. SAP) the period of return is much shorter.

Based on the foregoing, we can point out that the system implementation leads to the improvement of coordination, simplification of the process through the elimination of some unnecessary activities, reduction of the process duration and costs, improvement of the process quality, unburdening employees and consequently to the increase in their satisfaction, a partial improvement of related organizational units, better data management, as well as to opening up opportunities for implementation of other un/related organizational improvements (e.g. optimization of the number of employees, better performance monitoring etc.). Considered in relation to other systems, the advantages of the system are: a shorter period of implementation, lower costs of implementation, faster return on investment, lower volume of change etc.

During the system implementation and use, certain problems of much smaller scale and significance compared with the more complex systems could also occur. They are mostly organizational in nature, and related to unclear needs of users (they usually do not know what are the real problems, for what purpose they want to use the software, what are the most suitable processes for modeling etc.), resistance of employees towards the use of the system (fear of some employees due to the system transparency, the possibilities of determining a halt holder, the increased degree of control) and the like.

4. CONCLUSION

The rapid development of technology has created challenges in the field of the optimization of business processes. New information technologies offer great opportunities for the improvement and optimization of business processes. The optimization can be incremental or radical and, depending on the current state of the organization, it may include the whole organization or just certain parts. It can be the part of a broad or narrow organizational change. Likewise, the optimization does not have to refer only to the elimination of process activities, but also to the reduction of time and other resources. Considering technology as one of the main factors that affect changes in Human Resource Management (HRM), some authors explained that changes in technology "…transformed the way that organizations recruit, select, motivate, and retain employees" (Stone, Deadrick, Lukaszewski, & Johnson, 2015, p. 1). According to them, the growing importance of these changes is a consequence of the contemporary business approach based on the knowledge and talents of employees.

However, if company decides to conduct the informatization of business processes, it would be good first to conduct the evaluation of optimal software solution. Čudanov, Jaško and Saviou (2010, p. 37) in their research showed that the highest level of information and communication technology adoption is recorded in large and medium-sized enterprises. In our country, the largest number of enterprises are medium-sized enterprises where ERP or SAP cannot be effective, due to the lack of complexity of the processes, and those systems also require excessive implementation costs. The practice has shown that the WfMS software is an excellent tool for modeling processes of medium complexity.

In practice, it has been proven that Omega Workflow Manager System gives good results in processes from different organizational units (finance, procurement, sales, marketing, etc.). The system has been successfully implemented in some of the leading companies in Serbia: SBB - sales channels management, Mercator-S – work performance evaluation, online tests, legal documents approval, Coca-Cola Hellenic - processing applications, work performance evaluation, Vinča Institute of Nuclear Sciences – public procurements.

In the case of organization M, we saw that in human resources department only one process automation can lead to significant improvements in efficiency and effectiveness. Moreover, if the number of modeled processes increases, the total effect also increases due to the synergy effect. This kind of project represents an ideal opportunity for the analysis of the current working modes, and solving some core problems and the implementation of new ideas.
In this paper, we focused on the organizational aspects of business processes optimization. The subject of further research could include a cost-benefit analysis and also it would be interesting to investigate the effects of joint realization of system implementation and implementation of major organizational changes, such as corporate restructuring.

REFERENCES

Aguilar-Saven, R. S. (2004). Business process modelling: Review and framework. *International Journal of Production Economics , 90*, 129-149. doi:10.1016/S0925-5273(03)00102-6

Becker, J., Kugeler, M., & Rosemann, M. (2003). *Process Management - A Guide for the Design of Business Processes.* Berlin: Springer-Verlag. doi: 10.1007/978-3-540-24798-2.

Čudanov, M., Jaško, O., & Jevtić, M. (2009). Influence of Information and Communication Technologies on Decentralization of Organizational Structure. *Computer science and information systems, 6*(1), 93-109. doi:10.2298/CSIS0901093C.

Čudanov, M., Jaško, O., & Saviou, G. (2010). Interrelationships of organization size and information and communication technology adoption. *Journal of Applied Quantitative Methods, 5*(1), 29-40.

Davenport, T. (2005). The Coming Commoditization of Processes. *Harvard Business Review, 83*(6), 100-108.

Draheim, D. (2010). *Business Process Technology - A Unified View on Business Processes, Workflows and Enterprise Applications.* Heidelberg: Springer.

Hall, J., & Johnson, E. (2009). When Should a Process Be Art, Not Science? *Harvard Business Review, 87*(3), 58-65.

Hammer, M. (2007). The Process Audit. *Harvard Business Review* (April 2007), 1-14.

Jaško, O., Čudanov, M., Jevtić, M., & Krivokapić, J. (2013). *Projektovanje organizacije.* Belgrade, Serbia: Faculty of Organizational Sciences.

Lin, F.-R., Yang, M.-C., & Pai, Y.-H. (2002). A generic structure for business process modeling. *Business Process Management Journal, 8*(1), 19-41. doi: 10.1108/14637150210418610.

Lindsay, A., Downs, D. D., & Lunn, K. (2003). Business processes - attempts to find a definition. *Information and Software Technology, 45*(15), 1015-1019. doi:10.1016/S0950-5849(03)00129-0.

Mansar, S. L., & Reijers, H. A. (2007). Best practices in business process redesign: use and impact. *Business Process Management Journal, 13* (2), 193-213. doi: 10.1108/14637150710740455

Mentzas, G., Halaris, C., & Kavadias, S. (2001). Modelling business processes with workflow systems: an evaluation of alternative approaches. *International Journal of Information Management, 21*(2), 123-135. doi:10.1016/S0268-4012(01)00005-6.

Petković, M., & Lazarević, S. (2012). Managing Interorganizational Relations: Design of Shared Services Centre. *Management: Journal for Theory and Practice Management, 64*, 55-67. doi:10.7595/management.fon.2012.0024.

Porter, M. E. (2008). *Competitive advantage: Creating and sustaining superior performance.* New York: Simon and Schuster.

Radović, M., Tomašević, I., Stojanović, D., & Simeunović, B. (2012). *Inženjering procesa.* Belgrade, Serbia: Faculty of Organizational Sciences. ISBN 978-86-7680-259-3.

Ravesteyn, P., & Batenburg, R. (2010). Surveying the critical success factors of BPM-systems implementation. *Business Process Management Journal, 16*(3), 492-507. doi:10.1108/14637151011049467.

Reijers, H., Vanderfeesten, I., & van der Aalst, W. (2016). The effectiveness of workflow management systems: A longitudinal study. *International Journal of Information Management, 36*(1), 126-141. doi:10.1016/j.ijinfomgt.2015.08.003.

Stone, D. L., Deadrick, D. L., Lukaszewski, K. M., & Johnson, R. (2015). The Influence of Technology on the Future of Human Resource Management. *Human Resource Management Review*, Article in press. doi:10.1016/j.hrmr.2015.01.002.

Stroppi, L. J., Chiotti, O., & Villarreal, P. D. (2015). Defining the resource perspective in the development of processes-aware information systems. *Information and Software Technology, 59*, 86-108. doi:10.1016/j.infsof.2014.10.006.

Tsai, C.-H., Huang, K.-C., Wang, F.-J., & Chen, C.-H. (2010). A distributed server architecture supporting dynamic resource provisioning for BPM-oriented workflow management systems. *The Journal of Systems and Software, 83*(8), 1538-1552. doi:10.1016/j.jss.2010.04.001.

Van der Aa, H., Reijers, H. A., & Vanderfeesten, I. (2016). Designing like a Pro: The automated composition of workflow activities. *Computers in Industry, 75*, 162-177. doi:10.1016/j.compind.2015.04.005.

Vukicevic, S., & Milosevic, S. (2012). IT, Innovations and Sustainability. *Management: Journal for Theory and Practice Management, 65*, 79-84. doi:10.7595/management.fon.2012.0029.

ICT AND MANAGEMENT 754

COMPARATIVE ANALYSIS OF SCRUM AND KANBAN METHODOLOGIES FOR MANAGING INFORMATION SYSTEMS DEVELOPMENT 755
Pantelić Ognjen, Gajić Vedrana, Pajić Ana

APPLICATION OF MULTIMODAL BIOMETRICS IN ACCESS CONTROL SYSTEMS 762
Milenković Ivan, Živković Ksenija, Simić Dejan

OVERVIEW OF EAR BASED PERSON RECOGNITION ALGORITHMS 771
Krneta Sofija, Šošević Uroš, Starčević Dušan

PREVENTION OF FRAUD IN ELECTRONIC PAYMENT SYSTEMS 778
Bogićević Sretenović Marija, Petković Jasna, Jovanović Bojan

CASH, HASH OR TRASH - HASH FUNCTION IMPACT ON SYSTEM SECURITY 788
Zivadinovic Milos, Milenkovic Ivan, Simic Dejan

GIS IN BUSINESS MANAGEMENT 792
Kranjac Mirjana, Sikimić Uroš, Tomić Srđan

PROSPECTS AND TRENDS IN THE DEVELOPMENT OF TELEMEDICINE 799
Jovanovic Milenkovic Marina, Milenkovic Dejan, Ristic Slobodan

MODEL-DRIVEN APPROACH TO THE IMPLEMENTATION OF WEB SERVICE INTERFACES FOR 4GL SYSTEM 805
Vesić Slavimir, Aničić Nenad, Babarogić Slađan

ICT AND MANAGEMENT

COMPARATIVE ANALYSIS OF SCRUM AND KANBAN METHODOLOGIES FOR MANAGING INFORMATION SYSTEMS DEVELOPMENT

Ognjen Pantelić*[1], Vedrana Gajić[1], Ana Pajić[1]
[1]Faculty of Organizational Sciences, University of Belgrade
* Corresponding author, e-mail: pantelic.ognjen@fon.bg.ac.rs

Abstract: *Understanding of customer demands was always the weakest point in information systems development. Due to the inadequat understanding and defining business demands, numerous projects end up not being successfully finished. Being aware that client demands are changing, many companies decide to use agile methodologies which generally contribute to faster and more efficient information systems development. However, there are many tools and methodologies which are considered to be agile. Companies decide to use two or more methodologies for managing projects of information systems development, in order to use their advantages and adjust them to their business model. The goal of this paper is comparative analysis of Scrum and Kanban methodologies, as well as their tools, with the idea to integrate these two methodologies in order to use their best practices. The analysis shown in this paper is used for developing software tool called „ScrumbanTool", which presentation is going beyond this paper.*

Keywords*: agile methodologies, scrum, kanban, information systems development, project management*

1. INTRODUCTION

Information systems development consists of all activities related to analysis, design, development, and deployment. Considering the fact that technologies change with time, organisations need new systems or significant changes in the old ones, in order to fulfil their goals. This points out the fact that the information systems development is complex and continuous process.

Throughout software development, different methodologies developed that help information systems development. Numerous factors influence the choice of methodology, one of them being the support of methodology in managing the project of the information systems development. Project management is not only significant scientific discipline needed in every organization, but is also considered to be necessary for the survival of any company. Due to the changes in client's demands, many companies decide to use agile development methodologies which enable better focus on client's problems, shorter time for project realisation and faster and easier adjustment to changeable environment (Moniruzzaman & Hossain, 2013).

It is not so rare the companies decide to combine two or more methods for project managment, in order to use these methods in the best possible way and adjust them to their business model. With the development of agile methodologies, numerous software tools that enable easy survey of project and it's managing, are also developed. The goal of this paper is comparative analysis of Scrum and Kanban agile methodologies.

2. AGILE SOFTWARE DEVELOPMENT METHODOLOGIES

In the late 1990-ies, a group of designers (Ken Beck, Alstair Cockburn and others, founded Agile Alliance) was the creator of agile approach in the information systems development Supporters of agile software development methodologies bring in 2001 Agile Software Development Manifesto trying to emphasize the role the flexibility could have in more skilled and faster development of software product (Padavić, Velić, & Ljubobratović, 2011).

According to the Agile Manifesto (Fowler & Highsmith, 2001), some of the principles of agile methodologies are:

- The highest priority is to satisfy customer through early and continuous product delivery
- The change in demands is normal, even in the late project phases
- Software product that works, is delivered every few weeks or months
- The team periodically tests good and bad procedures, and tries to repair them for the next period

The principles represent conceptual framework which should be used during development of software product. Agile methodologies are subset of iterative and evolutional methods, and are based on iterative enhancement, while iterations (repetitions) are short in order to give correct information to project team.

Understanding of customer demands has always been the weakest point in the information systems development. Due to inadequate understanding and defining of business demands, some software development projects failed to fulfill customer expectations. Management of demands consists of activities which are dealing with detecting demands, following and controlling of versions and changes in demands. The change in demand is every change of the existing demand or new demand that can influence the existing demands.

Demand changes happen due to the changes in business environment or customer needs. Defining demands, according to the traditional methodologies, goes through phases of analysis, documentation and check. For many organizations, this is a process of few weeks or even months. Unlike traditional, agile practice deals with smaller parts of demands, which are developed and tested during one sprint (iteration) and, in the end, being presented to final customer, for demand validation. Identifying and development of agile demands is done during agile planning, development and delivery (Milanov & Njegus, 2012):

- Agile planning. Agile teams develop demands according to their business values, i.e.: profit increase, cost decrease, service improvement, harmonizing legislation, accomplishing market goals etc. Agility means focusing on the actual values and discarding everything that is not of great importance. Planning covers not only „current view“ (current iteration), but as well the review of the solutions and „big view“(the vision and the map of product development). Product owners are doing agile planning, by constantly reconsidering demand priorities and by validating risks and dependencies.
- Agile development. Agile development team estimates, develops, tests and demonstrates demands to final users. Before the beginning of Sprint, development team sketches data model, condition diagrams or interfaces, which also represents mini specification of the solution.
- Agile delivery. Demands are often dependent on one another. Agile teams analyze and optimize dependencies of the demands.

Predetermined length of the iteration is used as a time frame for the development team. According to the length of the iteration, the scope of the problems to be solved is being determined. The main difference between agile and iterative methodologies is the length of a single iteration. While the length of the iteration for iterative methodologies is three to six months, with agile approach the interval decreased to one to four weeks, and the most 30 days.

Some methodologies for information system product development based on agile principles are (Abrahamsson, Warsta, Siponen, Ronkainen, & Ronkanen, 2003), (Hiranabe, 2007):

- eXtreme Programming – XP
- Scrum
- Feature Driven Development – FDD
- Crystal family of methodologies
- Dynamic Systems Development Method – DSDM
- Adaptive Software Development – ASD
- Kanban

2.1. Scrum development methodology

The term „scrum“ originates from rugby and represents „throwing the ball back into the game“. This methodology is fast, adaptable and more and more popular among IT companies.

Initially, this agile methodology was developed as a set of management recommendations and suggestions for managing the information systems development project. Project development with Scrum methodology is done iteratively, and iteration is called Sprint. Sprint has to be predetermined and is recommended to last between two and four weeks (Pichler, 2010). After one Sprint, one draft version is ready for delivery, while the whole project can be done through three to eight sprints.

According to Scrum, complete system development is divided into three groups of activities: pregame, game and post-game (Gorakavi, 2009). Through pregame, demands and development priorities are being defined, and value of newly built increments is being estimated. Throughout the game, the development and functionality implementation are done iteratively, and in post-game period, testing and integration (Figure 1).

Scrum tools are making processes and activities of this methodology much easier. Many vendors are offering their versions of tools for project management that support Scrum, and some of them are with open code. Some of Scrum tools are: Agile Tracking Tool, Scrumwise, ScrumDo, Scrumy, Agilito, Agilo for Scrum, PangoScrum, Scrumpad, Rally Dev, Jira etc.

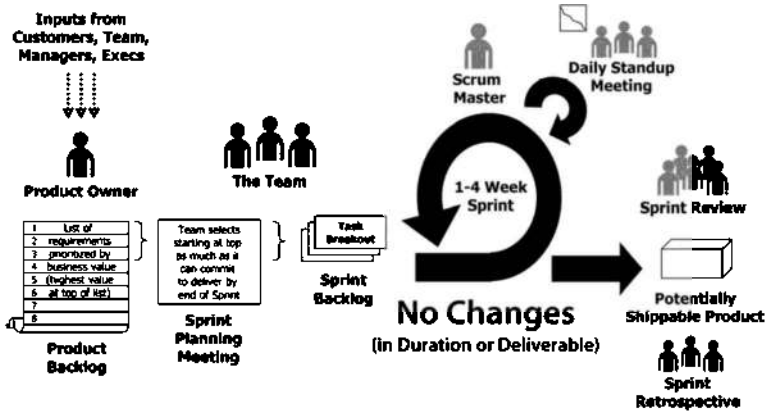


Figure 1: Scrum methodology through phases (Deemer & Benefield, 2010)

Jira is one of the best known Scrum tools. It is the product of Atlassian, and is used for project management. It is written in Java program language, and it also has its free version for projects with the open code (Atlassian, 2005). It is often used with systems for version control, such as SVNili Mercurial, and with Bamboo build server. The system enables communication within development team, as well as with a buyer or owner.

With very intuitive control board, it is possible to:
- Create, set projects
- Set schemes and workflow
- Work with tasks, as a main project unit
- Track task length and status
- Give priority and person in charge for every task
- Sort backlog etc.

2.2. Kanban development methodology

Kanban agile methodology of information systems development is following Lean software development. The term „lean" represents the motive to spend less amount of time, less human effort, less investment, less effort and less finances during development.

Kanban spread through production industry in the world, as the tool for Lean Manufacturing, and in agile information systems development, it is the way of project visualization by placing cards with assignments on the board, by which just in time – JIT development strategy is achieved (Wagener, Schmit, Mandal, & Vaishnavi, 2012). In Japanese vocabulary „kan" means „signal" while „ban" means „card" or „board".

Lean Kanban strategy is generally more focused on job being finished in time, instead of being focused on who did it. People work together, but they do not work with the same speed, they do not have the same knowledge and skills, so they have to synchronize (Anderson, 2010). In Kanban, the work is organized by tasks or processes, and allows team members to change on their own the workflow in the most productive way.

The rules of Kanban do not consider important demands that are not needed at the moment by anyone, do not write more specifications than can be programmed, codes are written in the amount that can be tested, and according to that, only what can be released is tested (Anderson, 2010). Kanban system in engineering is done in a way that all demands which are waiting in line are passing through few phases, until they are finished. When demand is in a phase „Finished" than it goes to the next phase.

The advantages of Kanban, compared to traditional „push" systems, are (Topić, 2012):
- Simple and understandable process
- Gives fast and precise information

- Low costs of transferring information
- Possible fast reply to changes
- Limited capacity in process
- Avoids hyper production
- Minimizes waist
- Easier control maintaining

Main Kanban principles which are continuously followed by the team are: visual control (Kanban board), Limit Work in Process – WIP, card pull, fix Kanban backlog. The usage of colored cards and their availability for different types of work, can enable development team too quickly:
- See what is currently being worked on (the cards give value to a certain job)
- Easily see blocker tasks
- Estimate how good was the analysis
- Do easy tracking (how many tasks exceeded time limit etc.)

If there is emergency case concerning support demands or mistake in software product (software bug) during production, than an empty space in Kanban board is used, under the name „Urgent". The tasks that are solved in this way are not being put into backlog, but the aim is to solve them as quickly as possible.

The advantage of Kanban board is visibility of the following (Hiranabe, 2008):
- The work of individual
- Is the individual overloaded with work
- Where is bottleneck
- Where problems in work occur
- What is being blocked

Some of the well-known web-based Kanban tools are: Lean Kit Kanban, Kanboard, Axosoft, Kanbanery, AgileZen, Flow, FogBugz Kanban, GreenHopper, Hansoft, LeanKit Kanban, Lino, Qanban, SilverCatalyst and others.

3. COMPARATIVE ANALYSIS OF SCRUM AND KANBAN METHODOLOGIES

- Comparison by the number of rules

These two methodologies can be compared by the number of rules they possess. If a certain methodology has more obligatory rules, that methodology is called prescriptive methodology. On the other hand, if methodology does not possess any rule, it is called adaptive methodology. Completely prescriptive methodology gives all the guidelines and rules, so everything organization needs to do is follow the rules, without any other efforts during project management, while completely adaptive methodology leaves everything to organization without any rule. Both extremes are very risky (Kniberg & Skarin, 2010).

Agile methodologies are generally referred to as light weight methodologies, because they are less prescriptive from traditional methodologies. Both Scrum and Kanban methodology are very adaptive, but compared to one another, Scrum is more prescriptive. Scrum possesses more limits and therefore has fewer options. For example, Scrum expects usage of time-limited iterations (sprints), while Kanban does not.

- Comparison by roles

There are three different types of roles in Scrum: Product owner, Development team and Scrum leader. There are no different roles for different members of team, in other words, there are no specific roles. This does not mean that the team organised around the project should not have its owner, but rather that it is not necessary.

On the other hand, both Scrum and Kanban are open to adding any other type of role if necessary. But there has to be precaution, in order to add new value to the product by adding new role, and not only conflicts with other elements of the process. Companies often add Project Manager to the team, who synchronises teams and product owner. However, since the global motto of both methodologies is „less is more", if organisation is having a dilemma, the recommendation is to start with less number of roles in a team.

- Comparison by meetings

Scrum team is having a short meeting every day at the same time and place. The goal of these daily meetings is to exchange information about development, plans for the next day and to point out any major problem if there is any.

Kanban does not imply daily meetings, but nevertheless most of Kanban teams have this habit. It is a great technique for any methodology.

Scrum form of meetings is mainly about people, since every person gives a report, one after another. Kanban teams use more Kanban board, and are focused on the problems that are visible on the board. The problem of this way occurs when many teams use the same board and have daily meeting together, because it is not always necessary to listen to other team's problems (Kniberg & Skarin, 2010).

- Comparison by time planning

Scrum is based on time-limited iterations. The team itself determines the length of iteration, but it is important that iteration always has the same length through the complete project development, or at least, one long period of time.

At the beginning of each iteration a plan is being formed, team plans certain and definite number of orders from backlog, based on the priorities of product owner. During iteration, team is focused on finishing orders that had been planned at the beginning of the iteration, while at the end of the iteration the team presents potentially finished product to stakeholders and gives a retrospective/discussion in order to improve complete process.

One Scrum iteration is time-limited sequence which combines three different activities (Kniberg & Skarin, 2010):

- Planning
- Continuous process improvement (retrospective)
- Releasing the product of iteration into production

When using Kanban methodology, the iterations are not predetermined. The team can decide at any moment when to plan, improve the process or release application into production. It can decide on one of the basic tactics, such as releasing application into production on Mondays, or when client demands, or i.e. only when application undergone significant changes or improvements (whenever something useful can be released).

- Comparison by boards (Scrum and Kanban board)

In Scrum, backlog of iteration shows everything that should be done during current iteration. This information is often shown by using cards on the wall, which is called Scrum or Task board.

Both Kanban and Scrum board follows numerous demands as an improvement or workflow. Let us say that both boards have three columns that represent condition of demands: To do, Ongoing, Done. Both methodologies do not limit teams concerning in which condition can demands be put in, so they can choose conditions that are more suitable for their process.

The difference between these two charts is that Kanban limits the number of orders per column. For example, in the column „Ongoing", there can be only 3 requests at the same time. Scrum does not have the rule that as prevention limits the team to put many requests at the same time in one column. On the other hand, Scrum limits the number of orders in the chart, because at the beginning of each iteration, the number of orders is being defined. Therefore both methodologies are limiting requests but in a different way.

Considering the fact that Scrum methodology functions with fixed number of requests within iteration, if a client wants to add a request in „To do" column, it would not be possible. If the team uses Kanban methodology, the request would be accepted only if the capacity of the column is not already full. Otherwise, the previous requests from that column would have to be finished first. Of course, none of these two approaches is exclusive. Scrum team can, as well, decide to allow product owner to change priorities in the middle of sprint, but it is considered an exception.

Another difference is that Scrum board is reset after each iteration, in other words, it is deleted after every sprint. New iteration starts after planning where the team will work, on a completely new Scrum board with new requests. In Kanban, the chart is mainly persistent, and there is no need for reset.

- Comparison by teams

Scrum team is functional team which consists of members who have necessary knowledge to solve any request in iteration (Figure 2). In Kanban, a team like that is only an option. It is important that requests can be fulfilled, but it is not important that every team member can solve every request (Figure 3).

Agile methodologies generally contribute to faster and more efficient information systems development. However, there are many tools and methodologies that are considered agile. That is why the choice of methodology that will be used is very important, and it should be taken into consideration if the methodology can be applied to all projects within organization.

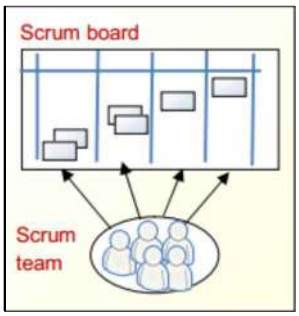


Figure 2: Necessary knowledge of Scrum development team (Kniberg & Skarin, 2010)

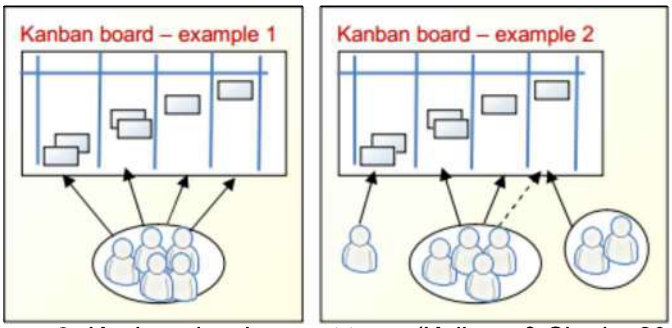


Figure 3: Kanban development team (Kniberg & Skarin, 2010)

Based on the comparison, it can be concluded that there is high number of advantages while using any of these two methodologies. Both methodologies are highly used and popular in the world and in IT companies in Serbia. Summarized overview of the most important differences in Scrum and Kanban approach is shown in Table 1.

Table 1: Differences in Scrum and Kanban methodology

Scrum	**Kanban**
Iterations are time limited	Time limited iterations are only an option
Uses speed and velocity measuring as metric	Uses lead time as metric
Team members have to be functional between themselves	Team members can be experts for only one necessary field of work
Time estimations are necessary	Time estimations are not determined
Forbids adding new requests if iteration is in progress	Enables adding new requests as long as capacity allows
Defines three types of roles	There are no predefined roles for team members
Scrum board is being reset after every iteration	Kanban board is persistent

Organizations have as well the possibility of combining these two methodologies. Teams can use those recommendations which are more suitable and helpful, making combination of Scrum and Kanban. Many Scrum teams decide to limit waiting lines, which is recommended by Kanban methodology. On the other hand, many Kanban users have daily meetings, like every Scrum team does.

4. CONCLUSION

Agile methodologies emphasize the importance of flexibility in more efficient information systems development. Product is being adjusted to the changes in user's requests, during development process itself. Changes in requests are normal and they happen after changes in business environment or user needs. Therefore the user is being more involved in product development process, after each iteration when smaller part of complete implemented requests is being validated.

This paper presented Scrum and Kanban methodologies for managing information system development, which are widely accepted and being used today. Lean Kanban strategy is more focused to have the job

finished in time, while there are no time limited iterations. By using special way of visualization, Kanban board, the project is being observed and focus is put on the problems on the board. Therefore this methodology does not imply characteristics of teams and daily meetings, unlike Scrum method. Scrum method is more rigorous and requests daily reports from every team member. It functions with fixed number of requests during iteration, which disables client to add any new request during the iteration. This situation can be overcome by Kanban method, so new request could potentially be accepted if there is enough capacity.

Based on the comparative analysis of Scrum and Kanban methodologies, as well as their tools, it can be concluded that these two methodologies can be used together successfully, by using only the best recommendations from both. Teams can use those recommendations that are suitable and helpful, by making a mixture of Scrum and Kanban methodology. Many Scrum teams decide for work in progress (WIP limit), which is Kanban recommendation. On the other hand, many Kanban users organize daily meetings like every Scrum team. It should be mentioned that a new software tool that gives the opportunity to combine Scrum and Kanban methodology by the name „ScrumbanTool", has been developed.

REFERENCES

Abrahamsson, P., Warsta, J., Siponen, M. T. M. T., Ronkainen, J., & Ronkanen, J. (2003). New Directions on Agile Methods: A Comparative Analysis. In *Proceedings of the International Conference on Software Engineering* (pp. 244–254). Portland, Oregon, USA. doi:10.1109/ICSE.2003.1201204

Anderson, D. J. (2010). *Kanban: Successful Evolutionary Change for Your Technology Business*. United States of America: Blue Hole Press.

Atlassian. (2005). JIRA User ' s Guide. Retrieved from http://apply07.grants.gov/apply/opportunities/instructions/oppMARWAN-020610-cfda00.000-cidMARWAN-020610-instructions.pdf

Deemer, P., & Benefield, G. (2010). *The scrum primer (An Introduction to Agile Project Management with Scrum). Goodagile-Scrum Training in India and Asia, (1.04)*. Retrieved from http://www.rallydev.com/documents/scrumprimer.pdf\nwww.goodagile.com

Fowler, M., & Highsmith, J. (2001). The Agile Manifesto. *Software Development*, *9*, 28–35. doi:10.1177/004057368303900411

Gorakavi, P. K. (2009). Build Your Project Using Scrum Methodology. *IPMA USA*, pp. 1–5. Retrieved from http://www.ipma-usa.org/articles/A3_AboutScrum.pdf

Hiranabe, K. (2007). Visualizing Agile Projects using Kanban Boards. Retrieved from http://www.infoq.com/articles/agile-kanban-boards

Hiranabe, K. (2008). Kanban Applied to Software Development: from Agile to Lean. Retrieved from http://www.infoq.com/articles/hiranabe-lean-agile-kanban

Kniberg, H., & Skarin, M. (2010). *Kanban and Scrum-making the most of both* (Vol. 1). United States of America: C4Media Inc., Publisher of InfoQ Enterprise Software Development.

Milanov, G., & Njegus, A. (2012). Upravljanje izmenama zahteva u skladu sa modifikovanim Scrum procesom. In *Proceedings of Telecommunications Forum (TELFOR), 2012 20th*, 1685–1688. Belgrade.

Moniruzzaman, A. B. M., & Hossain, D. S. A. (2013). Comparative Study on Agile software development methodologies. *Global Journal of Computer Science and Technology*, *13*(17), 1–25.

Padavić, I., Velić, M., & Ljubobratović, D. (2011). Agilni razvoj programskih proizvoda agile software development. In *Proceedings of Infoteh- Jahorina Conference* Vol. 10, 466–470.

Pichler, R. (2010). *Agile Product Management with Scrum: Creating Products that Customers Love. AddisonWesley Professional*. United States of America. doi:10.1111/j.1540-5885.2011.00829_2.x

Topić, A. (2012). *Utjecaj Kanban agilne metodologije na razvoj programskog proizvoda*. Faculty of Electrical Engineering, University of Split.

Wagener, J., Schmit, S., Mandal, A., & Vaishnavi, R. (2012). *Project Management Using Kanban*. Retrieved from http://www.pmi.lu/event/120201-Using.pdf

APPLICATION OF MULTIMODAL BIOMETRICS IN ACCESS CONTROL SYSTEMS

Ivan Milenković, Ksenija Ţivković, Dejan Simić
Faculty of organizational sciences

***Abstract**: Access control systems are part of our everyday reality. The choice of an authentication method has a significant impact on an access control system. Topic of this paper is possible application of multimodal biometrics in access control systems. Relevant papers and solutions are analyzed, and a review of different aspects of multimodal systems is given. Analysis results show that multimodal biometric systems have some significant advantages over unimodal biometric systems and other authentication methods. However, use of multimodal biometrics as authentication method may result in increased cost and lesser system usability.*

***Keywords**: multimodal biometrics, access control, performance evaluation*

1. INTRODUCTION

Increased risk of attacks such as identity theft has raised the importance of properly implemented systems for identity and access management. Identity and access management refers to an integrated system of business processes, policies and technologies which enables organizations to simplify and control user access to online applications and resources, while protecting confidential information from different types of attack (Bogićević, Milenković and Simić, 2014).

An identity and access management process has three interdependent main activities (Milenković, Šošević and Simić, 2012) - user identification, authentication and authorization. Process of claiming user identity is called identification, while the act of verifying claimed identity is defined as authentication. Authorization is the process of asserting user rights to access some resources, such as data, computer devices or offices.

Main goal of access control is controlling the activity of the system users. According to Sandhu and Samarati (1994), access control assumes that user has been successfully verified before enforcement of access control policies. Therefore, the effectiveness of the access control systems depends on reliable authentication of its users.

There are three main types of authentication methods today. First and the most common is the use of passwords. Password is something that system user knows. However, this knowledge can be easily shared with other people, or as easily forgotten. Also, people may choose passwords of insufficient security. Some of those security problems can be solved by the use of tokens. Token is something that system user possesses. Potential danger is that tokens can be stolen and system security compromised. Third type of authentication, biometrics, tries to overcome shortcoming of other authentication methods. Biometrics uses physiological or behavioral traits of a person for authentication, something that user is.

Biometrics relies on statistical or machine learning algorithms, and algorithm output is not a definite yes/no, but a score or probability (Šošević, Milenković, Milovanović and Minović, 2013). Therefore, biometric systems can make errors. One approach to making biometric systems more precise and robust is the use of multimodal biometrics. Multimodal biometrics relies on combination of several different biometric modalities. Different combinations are possible, such as face and voice, fingerprint and iris, face, ear and palmprint.

In order to secure an access control system, it is necessary to have a secure authentication procedure. In chapter 1, introduction to biometrics and access control was given. Topic of chapter 2 is performance evaluation of biometric systems. In chapter 3 different information fusion algorithms are described, and estimates of their precision are given. Chapter 4 is concerned with security of biometric systems. In chapter

5, different applications of multimodal biometric in access control are reviewed. Conclusions and guidelines for multimodal biometrics use in access control are given in chapter 6.

2. PERFORMANCE EVALUATION

According to Phillips, Martin, Wilson and Przybocki (2000), there are three different approaches for biometric system evaluation: technology evaluation, scenario evaluation and operational evaluation. The most general type of evaluation is technology evaluation.

Technology evaluation is used to determine performance of biometric algorithms. It involves the use of the standardized database for testing purposes. Performances of different algorithms can be compared on a common set of data. All the algorithms use the data gathered by the same type of acquisition devices. Only part of a database is given to algorithm developers, and the rest of the data is used for final evaluation. An example of technological evaluation is the FERET(face recognition technology) evaluation conducted by NIST.

Open-access multimodal biometric databases suitable for technology evaluation are few. Also, they tend to have biometric data collected from a small number of individuals. Therefore, researchers who want to test multimodal algorithm have to use chimeric datasets (Poh and Bengio, 2006). For fusion algorithms that work on the match score level, there is a possible alternative in using a NIST database with face and fingerprint match scores.

Numerous published papers confirm that multimodal biometrics improve system performance. Researchers have tested their algorithms on different sets of data, because of a lack of suitable multimodal database. Sim, Asmuni, Hassan and Othman (2014) have developed a multimodal system which uses biometric modalities of iris and face. For testing, they have created their own UTMIFM dataset (Universiti Teknologi Malaysia Iris 188 and Face Multimodal Datasets). For comparison, they have also used ORL database (Samaria and Harter, 1994) for face images, and UBIRIS v.2 iris dataset (Proenca and Alexandre, 2005).

Scenario evaluations are used to determine system performance in a specific domain of application. In a scenario evaluation, we would determine if a face recognition system can be used for access control at an airport. Biometric system is being tested as whole, and both algorithms and acquisition sensors are being tested. Testers should be chosen from population of real-world biometric system users. For example, in security applications, subject may be unwilling to cooperate with the system, which is a very important distinction. System environment, such as noise or lightning should match real world scenario as close as possible. Also, data enrolment must be done under same general conditions. Results of the scenario evaluation are partly repeatable, in according to the extent of the scenario that can be controlled.

Operational evaluations are used to determine system performance for a specific application. Example for operational evaluation would be testing a face recognition system for access control on Belgrade “Nikola Tesla” airport. There is little control over testing procedure, as subject should use the system in standard way. Evaluation results are not repeatable, because each specific application environment has specific characteristics which are hard to document.

3. MULTIMODAL BIOMETRICS - ALGORITHMS AND SYSTEM PRECISION

Multimodal biometric systems integrate information gathered from different biometric modalities. Different combinations are possible, such as fingerprint and face, voice, face and ear, iris and fingerprint. To integrate information gathered from different modalities, the use of information fusion algorithm is necessary. Choice of the fusion algorithm can have a significant impact on the system precision and performance. A classification of information fusion methods is shown on picture 1.

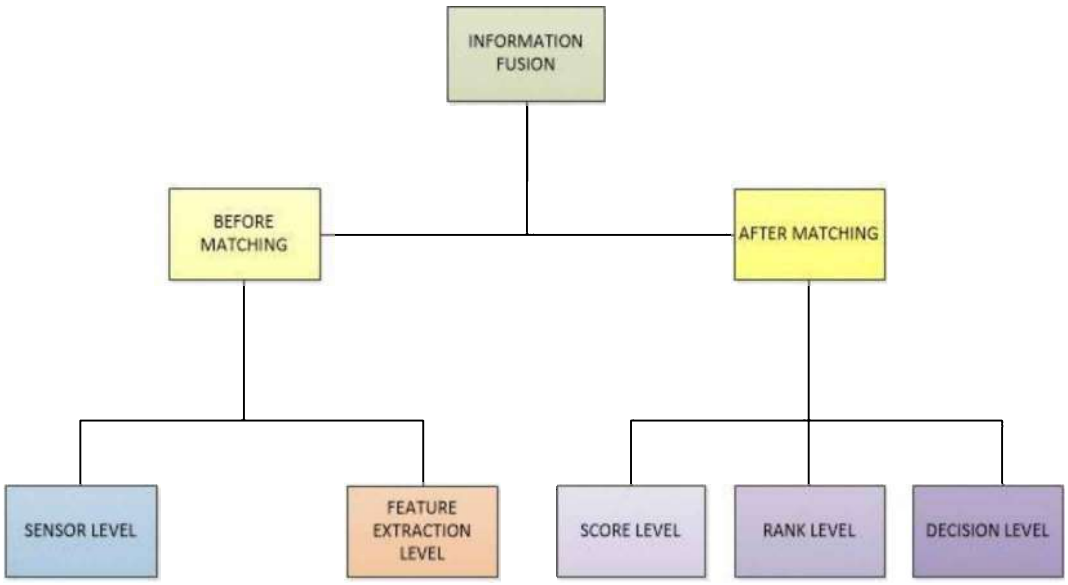


Figure 1: Different levels of information fusion in multimodal biometrics

3.1 Sensor level fusion

Data gathered from several types of sensors is integrated into single entity. At this level it is possible to fuse data from just a single biometric modality, so these methods are more likely to be considered multibiometrics than multimodal biometrics. It is important for consideration because this kind of fusion can improve system inputs.

3.2 Fusion at feature extraction level

Combining biometric characteristics extracted from several biometric modalities into a single biometric characteristic is considered as fusion at feature extraction level. Fusion methods defer from simple vector concatenation to more complex fusion methods.

Saini and Sinha (2014) describe a multimodal biometric system based on Gabor-Wigner transform. GWT is used for extraction of feature vectors. Biometric modalities used are face and palmprint, and test database had 150 subjects. Authors compare system performance with information fusion on different levels. When information fusion was employed at feature extraction level, best system EER was 3,36%. Information fusion at match score level yielded 1,89% EER.

3.3 Match score level fusion

In case of score level fusion, separate biometric characteristics are generated for each biometric modality. Each of the characteristics is matched with according template in the biometric database. The result of the matching is matching score. The greater the similarity between matched templates, the match score has the higher value. Generated match scores are used to generate new, derived match score, or are directly used to make a decision. Most of the published papers use this fusion method.

One of the first large scale evaluation of multimodal biometric system was performed by Snelick et. all (Snelik, Kisku, Bicego and Tistarelli, 2007). Prior evaluations where based on non commercial software, and smaller databases. Tests were conducted on a database of 972 system users. Fingerprint and face were used as biometric modalities. Fusion was performed on matching score level. Different combinations of score normalization and fusion techniques were applied. User weighted fusion and adaptive normalization where the most precise combination with EER of 0.63%.

Sim, Asmuni, Hassan and Othman (2014) have developed a multimodal system which uses biometric modalities of iris and face. Paper focus was toward non-ideal images, such as off-angles, reflections,

expression changes or blurred images. Information fusion is performed on score level, and matching scores weights are customized for each system user. For testing, authors have created their own UTMIFM dataset (Universiti Teknologi Malaysia Iris 188 and Face Multimodal Datasets). For comparison, they have also used ORL database for face images, and UBIRIS v.2 iris dataset. Results for multimodal approach show GAR of 95% when FAR is 0.01%, while at same FAR iris and face perform at 94% and 83% percent, respectively.

Table 1: Comparison of different fusion methods

Paper	Published	Biometric modalities	Level of fusion	Number of identities in test dataset	Unimodal systems EER	Multimodal system EER
Snelick, Uludag, Mink, Indovina and Jain, 2005	2005	fingerprint and face	Match score level	972	2.16% 3.96%	0.63%
Vatsa, Singh and Noore, 2007	2007	iris and face	Match score level	300	2%, 2.3%	0.8%
Sim, Asmuni, Hassan and Othman, 2014	2014	iris and face	Match score level	300	~7%, ~3%	~2%
Saini and Sinha, 2014	2014	face and palmprint	Feature extraction level	150	5.77%, 11.67%	3.36%
Monwar and Gavrilova, 2009	2009	face, ear, signature	Rank level	30	~5.6%, ~7.5% ~5%	1.12%

3.4 Decision and rank level fusion

If a biometrical system functions in the identification mode, it is possible to use rank method fusion. Such system could produce an ordered list of identities as an output. The first candidate on the list is the one system determined a most likely match, followed by the other candidates ranked by their match probabilities.

Some commercial unimodal biometric system function as black box systems and their only output is final decision. Integrating such unimodal systems into a multimodal recognition system requires the use of decision level fusion. Decision level fusion applies different voting algorithms to calculate the final decision. Monwar and Gavrilova (2008) describe a biometric system with decision level information fusion. Applied algorithms are AND/OR, majority voting, weighted majority voting and behavioural knowledge space.

4. SYSTEM SECURITY AND PRIVACY CONCERNS

Although using biometrics as authentication technique may result in improving system security, it does not necessarily imply that the system is secure. To achieve this desired security, various system aspects, both technological and organizational should be taken into account. Applying traditional cryptographic algorithms to secure communication channels, using biometric cryptosystems to secure biometric templates are just some of the security measures needed to be taken.

Prabhakar, Pankanti and Jain (2003) noted that biometric usage also rises some privacy concerns. Finding the balance between privacy and the public interest is a serious challenge, which has technological and legal complexity. There are debates whether biometric data should or should not be considered a "private" or "sensitive" data, and there are strong arguments for and against. For example, a company may collect fingerprint or facial data of its employees for its access control system. Company employees may use these same biometric modalities in some other system that uses biometric authentication, such as a health care

system. However, if biometric data is not properly secured, company could theoretically use this biometric data to gather information about health issues of its employees.

Adversary attacks generally exploit the system vulnerabilities at one or more modules or interfaces. Figure 2 shows eight points of attack in a biometric system.

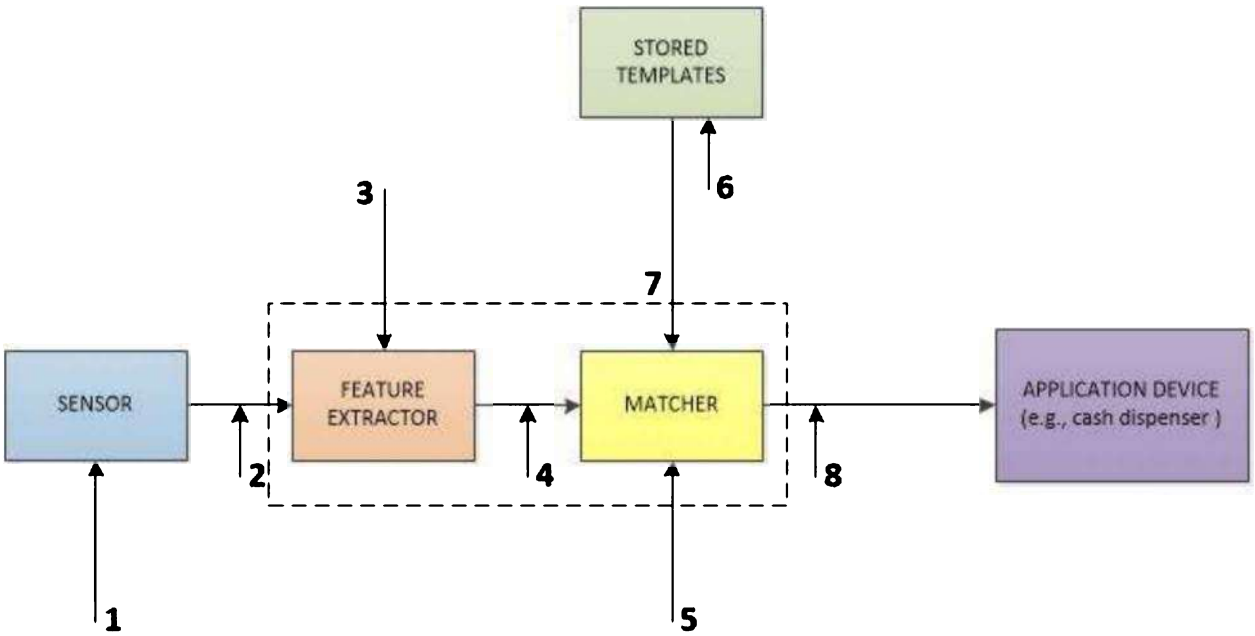


Figure 2: Points of attack in a biometric system (Ratha, Connel and Bolle, 2001)

1. Fake biometric submission at the sensor (fake finger, a copy of a signature, a face mask)
2. Resubmission of old digitally stored biometrics signal
3. Override feature extract (the feature extractor could be attacked with a Trojan horse)
4. Tampering with the feature representation (During the transmission of data between modules of extraction and corresponding modules, changing the desired set of functions)
5. Overriding matcher decision (Matcher also may be exposed to the Trojan horse)
6. Tampering with stored templates (The database of enrolled templates is available locally or remotely. The stored template attacker tries to modify one or more templates in the database)
7. Channel attack between stored templates and the matcher (attacks may change the contents of the templates before they reach the matcher)
8. Decision override (The final decision may be approved or not – YES/NO)

During the transmission of biometric data between acquisition sensor and feature extraction module there is a risk of eavesdropping. To prevent this attack, it is necessary to secure the communication channel. One approach is the use of smart cards, where the whole biometric system is integrated in such device. However, such solution is applicable only for certain scenarios of biometric verification. Some of the systems require external acquisition devices, or centralized biometric database.

A possible solution for this attack, and also other attacks which affect communication channels, is the use of cryptographic techniques. In smaller systems, where it is possible to exchange keys, symmetric cryptographic algorithms may be used. To prevent replay attacks, timestamps can be employed. In other, more complicated instances, it is necessary to protect the channel with some more complex solutions, like SSL/TLS protocol. Also, because biometric data is highly sensitive, multiple layers of protection (as used in financial transactions) should be applied.

5. APPLICATION OF MULTIMODAL BIOMETRICS IN ACCESS CONTROL

Many researchers studied multimodal biometrics in access control. Different applications of multimodal biometrics have been considered by the research community. Covered topics differ from more general, like securing access to a building or authentication for online systems, to more specific. Some of the more specific topics covered are car access control, application of multimodal biometric access control e-commerce systems access, and use of mobile devices.

Lupu (2011) proposed car access control using multimodal biometrics. System uses three biometric modalities - fingerprint, iris and voice recognition. Genuine system users are granted unlimited access to car controls. If an imposter would try to assume the car driver identity, he would be unable to drive the car. Also, the car would alarm security service or police using a GPRS system.

Maheswari et al. (2010) also used three biometric features, but instead fingerprint they used voice. Actually, they demonstrated an intelligent multimodal biometric verification system for physical access control using iris, face and fingerprint recognition. This system was created to show high security access control using multimodal biometrics. Another paper with building access control as the topic was published by Beattie et al. (2004). Paper describes a variation of sequential information fusion, based on so called path fusion algorithm. This new approach is designed for building with several authentication checkpoints. User motion through building is monitored and each system decision is influenced by previous authentications.

Common feature of the following papers is the use of hand geometry for access control. Ribaric et al. described an economical approach of multimodal biometrics in access control. They designed a prototype biometric identification system using hand-geometry, finger and palm-print. The system is based on a low-cost desktop scanner, which is used as the biometric acquisition device. Experimental analysis revealed that information fusion at the matching-score level enhances the results of the identification. Chike Obed-Emeribe (2013) stated that the palm geometry and the fingerprint are most suitable for verification. He presented implementation of multimodal biometrics as an access control tool for an e-commerce framework. Framework architecture consists of an e-commerce database server, a monitor server for transaction processing and a multimodal biometric database server.

Dehnavi and Fard (2011) proposed a multimodal biometric model for tracking students in virtual classes. Proposed model combines two behavioral biometric characteristics (mouse movements and keystroke dynamics) and a physical one (face features). This new approach allows continuous verification of student attendance. This is achieved by applying specially designed algorithm called ACT (Attendance Control Tracker). Student biometric data is continually sent to biometric server. Paper gives an architecture proposal of the described system. Testing was performed on Claroline open source LMS, and authors state that model is applicable for use with other LMS.

Trewin et al. (2012) tested usability of voice, face and gesture recognition as access control methods for mobile devices. For comparison 8-digit written and spoken PIN codes were used. Study did not take biometric system performance into account. However, because authentication causes interruption in the user's primary task flow, the impact of authentication methods on working memory was taken into account. Research results have shown that each modality has its own strengths and weaknesses. Voice was considered less usable than other modalities, because of the acquisition problems. Study participants also reported interference with the memory tasks. Combination of face and voice result in higher FTA (Failure to acquire) rate because acquisition process required more coordination.

Several commercial multimodal biometric access control systems are available on the market. One of the latest solutions in access control is Facebanx. It combines face recognition, voice recognition and document verification. For Facebanx users, first step of the registration process is adding personal data, followed by biometric data acquisition. Final enrollment step requires submitting some kind of personal ID. To prevent fraud data entered is compared to data on the identification document. Another available multimodal biometrics solution for access control is Vision-Box, the new application of biometrics for airline passengers. It is designed for automated border control at airports. It supports iris, fingerprint and facial recognition biometrics and can integrate with the advanced identity management infrastructure.

Another important area where multimodal biometrics is applied for access control are government systems, like voting or border control systems. For example, Kenya and Ghana have improved their voting systems by introducing automatic biometric recognition. Biometric modalities of fingerprint, iris and face are used for voter verification. Iris, palmprint, facial and vascular recognition are employed for voter verification. Governments of USA and Canada collect face and fingerprint data from visitors, students or temporary workers from certain countries.

6. CONCLUSION

Research papers available on the topic multimodal biometrics confirm that multimodal biometrics significantly improves system precision. However, it is difficult to compare different multimodal algorithms and approaches. Even in the case of the same combination of biometric modalities, unimodal systems and testing data often differ. Lack of multimodal databases with large number of subjects in the public domain leads to use of chimeric datasets gathered from various different sources. A framework for evaluating precision of multimodal biometric systems is still an open challenge.

Application of multimodal biometrics can remove some of the negative effects of biometric menagerie. This is achieved by applying user specific fusion, where poorly performing modalities are given lower priorities, or are not used for authentication. Therefore, the use of multimodal biometric leads to more precise and robust system.

Interoperability is still an open issue. Although there are several standards and projects, none are widely accepted for now. Some of the standards, like BioApi, depend on a specific programming language. Other, like WS-BD, target just one segment of biometric systems (acquisition). Integrating different unimodal components into a multimodal system could pose a serious challenge. However, this area is still in development.

Multimodal biometric systems share security threats of their unimodal counterparts. Some of the treats can be countered by applying standard security measures used in computer systems. However, securing biometric templates remains an open question, as all algorithms proposed so far negatively affect system precision. Multimodal biometrics can be useful here, because using several modalities improves system precision and counters some of the negative effects.

As a tool for access control, multimodal biometric systems are not yet widely accepted. There are some papers which speculate over potential use of multimodal biometrics for this purpose, however, they are not still very numerous. Although commercial multimodal biometric solutions are available on the market, they are not widely spread yet. Some governments, like USA and Canada gather several biometric modalities for border control, but resort to unimodal fingerprint recognition for most purposes.

After reviewing different aspects of multimodal biometrics, we can conclude that they have some important advantages over their unimodal counterparts, and against other authentication methods. However, when deciding whenever to apply multimodal, there are always other factors to be considered, such as implementation cost and usability. Generally, the technology is mature enough to applied, and we can expect its more widespread use in the near future.

REFERENCES

Beattie, M. et al (2004). *Building* access control using coordinated biometric verification. In *Biometrics:Challenges arising from Theory to Practice (BCTP) Workshop Proceedings*, Cambridge, UK.

Biometric scores set, NIST. Retrieved from http://www.nist.gov/itl/iad/ig/biometricscores.cfm

Bogićević, M., Milenković, I., Simić, D.(2014) Identity Management – A Survey in M. Levi-Jakšić, S. Barjaktarević, M.Martić *Innovative Management and Firm Performance*.(ch. 19). Palgrave Macmillan

Chike, O. (2013). Multimodal Biometric Technology System Framework and E-Commerce in Emerging Markets. *International Journal of Advanced Computer Science & Applications*, 4(7), 192–196.

Claroline LMS. Retrieved from http://www.claroline.net/

Dehnavi, M. K., & Peykanpour Fard, N. (2011). Presenting a multimodal biometric model for tracking the students in virtual classes. *Procedia-Social and Behavioral Sciences* 15, 3456-3462.

Facebanx multimodal biometric solution. Retrieved from http://www.facebanx.com/face-voice-document-verification.php

Face Recognition Technology, NIST. Retrieved from http://www.nist.gov/itl/iad/ig/feret.cfm

Hiew, S., Hishammuddin, A., Rohayanti, H., Razib, O.(2014) Multimodal biometrics: Weighted score level fusion based on non-ideal iris and face images. *Expert Systems with Applications*, 41(11), 5390-5404. Retrieved from http://dx.doi.org/10.1016/j.eswa.2014.02.051.

Lupu, C.(2011) Car access using multimodal biometrics. *The USV Annals of Economics and Public Administration* 10(3), 368-377.

Mayank, V., Richa, S, Afzel, N.(2007) Integrating image quality in 2v-svm biometric match score fusion. *International Journal of Neural Systems*,17(5), 343-351

Monwar, M.; Gavrilova, M.L.(2009). Multimodal Biometric System Using Rank-Level Fusion Approach. *IEEE Transactions on Systems, Man, and Cybernetics, Part B: Cybernetics*, 39(4), (867-878)

Maheswari, U., Anbalagan, P.(2010) An intelligent multimodal biometric system for high security access. *International Journal of Biometrics*, 2(3), 295-311.

Milenković, I., Šošević, U., Simić, D.(2012) Architectures of comprehensive identity and access management. Paper presented at the *Electronic International Interdisciplinary Conference*. ISSN:1338-7871, ISBN 978-80-554-0551-3.

Monwar, M.,Gavrilova, M.L.(2008). A Robust Authentication System Using Multiple Biometrics. *Computer and Information Science Studies in Computational Intelligence*,189-201

M2SYS voting system. Retrieved from http://www.m2sys.com/automated-fingerprint-identification-system-afis-voter-registration.htm

Phillips, P.J.; Martin, A; Wilson, C.L.; Przybocki, M.(2000). An introduction evaluating biometric systems. *Computer* ,33(2),56-63.doi: 10.1109/2.820040

Poh, N.; Bengio, S.(2006) Using Chimeric Users to Construct Fusion Classifiers in Biometric Authentication Tasks: An Investigation. Presented at the *IEEE International Conference on Acoustics, Speech and Signal Processing.*

Proenca, H., & Alexandre, L. (2005). UBIRIS: A noisy iris image database. In F. Roli & 998 S. Vitulano (Eds.),Image analysis and processing-ICIAP 2005, 970–977. Berlin 999 Heidelberg: Springer. Vol. 3617

Prabhakar, S.; Pankanti, S.; Jain, A.K. (2003) Biometric recognition: security and privacy concerns. *Security & Privacy, IEEE*, 1(2), 33-42.

Proenca, H., & Alexandre, L. (2005). UBIRIS: A noisy iris image database. In F. Roli & S. Vitulano (Eds.),Image analysis and processing-ICIAP 2005, 970–977. Berlin 999 Heidelberg: Springer. Vol. 3617

Ratha, K., Connell, J. Bolle, R.M.(2001). An analysis of minutiae matching strength in the *Proceedings of the 3rd International Conference on Audio- and Video-Based Biometric Person Authentication (AVBPA '01)*, 223–228, Halmstad, Sweden, June 2001

Rattani, A.; Kisku, D.R.; Bicego, M.; Tistarelli, M.(2007). Feature Level Fusion of Face and Fingerprint Biometrics. presented at the First IEEE International Conference on Biometrics: Theory, Applications, and Systems, 27-29 Sept. 2007

Ribaric, S.; Ribaric, D.; Pavesic, N., (2003). Multimodal biometric user-identification system for network-based applications. IEE Proceedings Vision, Image and Signal Processing, vol.150, no.6, 409,416, 15 Dec. 2003

Ross, A., Nandakumar, K., & Jain, A. (2006). Handbook of Multibiometrics (International Series on Biometrics). Springer-Verlag New York, Inc., *Secaucus*, NJ, USA.

Ross, A., & Govindarajan, R.(2005) Feature level fusion of hand and face biometrics in Proc. SPIE 5779, Biometric Technology for Human Identification II, 196 (April 05, 2005); doi:10.1117/12.606093.

Saini, N., Sinha, A.(2014) Face and palmprint multimodal biometric systems using Gabor–Wigner transform as feature extraction*, Pattern Analysis and Applications,* 18(4),921-932

Samaria, F. S., & Harter, A. C. (1994). Parameterisation of a stochastic model for 1017 human face identification. In Proceedings of the second IEEE workshop on 1018 applications of computer vision, 138–142.

Sandhu, R.S.; Samarati, P.(1994). Access control: principle and practice. Communications Magazine, IEEE, 32(9),40-48. doi: 10.1109/35.312842

Snelick, Robert; Uludag, U.; Mink, Alan; Indovina, M.; Jain, A. (2005). Large-scale evaluation of multimodal biometric authentication using state-of-the-art systems, *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 27(3),450-455, doi: 10.1109/TPAMI.2005.57

SET Secure Electronic Transaction Specification (V1.0) Book 1. Mastercard and Visa. May 1997.

Šošević, U., Milenković, I., Milovanović, M., Minović, M.(2013). Support Platform for Learning about Multimodal Biometrics. *Journal of Universal Computer Science*, 19,(11), 1684-1700.

US-Visit border control program. Retrieved from http://travel.state.gov/content/visas/english/general/border-biometrics.html

Vision-Box solution. Retrieved from http://www.vision-box.com/

OVERVIEW OF EAR BASED PERSON RECOGNITION ALGORITHMS

Sofija Krneta*[1], Uroš Šošević[1], Dušan Starčević[1]
[1] Faculty of organizational sciences, University of Belgrade,Belgrade
*Corresponding author, e-mail: sofija.krneta@mmklab.org

Abstract: *Biometric modalities in person recognition process were subject of interest for many scientists over the years. In order to make image evidences more reliable, law enforcement was the first one to see the potential in parts of the body for person recognition. One of biometric modalities that has a lot of potential but is still in developing phase is human ear. This paper explores current available algorithms, analyzes most significant ones and suggests place for improvement or focus of further research for the authors.*

Keywords*: human ear, ear based recognition, person recognition, biometric systems, multimodal biometrics*

1. INTRODUCTION

Although the beginnings of using biometric technologies are dating back to 1858 (Komarinski, 2005), their benefits are still not completely utilized. Of course some of biometric modalities already found their application in practice and are used for identification and verification of individuals in various circumstances. However, some biometric traits have not yet been researched enough to be used in real conditions. These facts represent one of the reasons why biometrics as a technology was present in only 20.5 percent of organizations that participated in the Computer crime and security survey conducted by FBI and Computer Security Institute (Richardson, 2011) on an annual basis. Most of used biometric systems rely on biometric modalities with high level of reliability such as fingerprint and iris. Unfortunately, those modalities are also highly intrusive. Immediately following these modalities are some less reliable modalities - face, ear, voice and gait. Those modalities are also subjects to occlusion and imitation which can drastically lower the reliability of the biometric system. On the other hand, they do not require that the person cooperates in recognition process. It is clear that low reliability of mentioned biometric modalities prevents wide application of biometrics. However, their unintrusiveness makes them popular for usage in applied biometric systems.

There is one popular approach that may increase the reliability of biometric systems - multimodal biometrics. Multimodal biometrics refer to usage of several biometric modalities in one biometric system. More precisely, multimodal biometrics combine information acquired with different biometric sensors in order to increase the rate of accurate recognition. Project “Multimodal biometrics in identity management”, funded by Ministry of Education and Science of Serbia (Starčević et al., 2014) is focused on application of multimodal biometrics in identity management. During the research in field of biometrics, researchers engaged in this project were exploring each of the modalities and their utilization in multimodal biometric recognition. One of the promising biometric modalities for person recognition is human ear. It is known that the structure of human ear is not only unique, but also constant as the ear does not change over the course of human life. Additionally, this biometric modality does not require person"s consent to recognition and thus it is considered as non intrusive (Pflug and Busch, 2012). In order to utilize human ear in biometric recognition process, system usually uses ear images. Ear images can be acquired on itself or it can i.e. be isolated from image of a person"s face. This fact also makes human ear an interesting biometric modality which is constantly researched in the last several years.

This paper focuses on algorithms used in person recognition based on human ear. In the next chapter, human ear as a biometric modality is presented and also ear biometric systems are described. Additionally, some applications of human ear as a modality in multimodal biometric systems are given. List of currently available ear recognition algorithms is given in third chapter. The algorithms are chronologically listed and also categorized in this chapter. Fourth chapter focuses on most popular ear recognition algorithms, their way of functioning, advantages and disadvantages. Conclusions and future work regarding the person recognition based on human ear are defined in the last chapter.

2.PERSON RECOGNITION BASED ON EAR BIOMETRIC SYSTEM

Ear biometric system can be defined as a typical pattern recognition system where the input image is reduced to a set of features that is subsequently used to compare against the feature sets of other images

in order to determine its identity (Abaza, 2013). It is a system that receives image as an input, uses details key features of human ear and gives person recognition as an output result. Person recognition can be used in two ways: Verification and Identification. Verification process uses ear features of an exact person to compare and verify person"s identity. Identification uses existing database to recognize which of existing features match features received as an input. Since identification process is iterative process through existing database, it"s duration is longer. However, the main recognition process stays the same, thus the output of person recognition process is identical - a match to a person in the existing database.

Physiological (anatomical) biometrics methods are based on the physiological features of humans. They measure and compare features of specific parts of human body in the process of recognition. So far the most interesting biometric modalities for researching are face, iris and fingerprint features since they are the most important discriminants of human identity (Perales and Draper, 2004). The advantages of anatomical biometrics can be summed into following statements:

- Acquisition of the data for input is a passive process and does not require participation of the person that is about to be included
- Acquired data is typically invariant over time, easy to acquire, and unique to each individual.

There haven"t been many efforts in application of human ear for personal authentication, even though it has proved its significant role in forensics. The main characteristics of the human ear that make it a good candidate for person recognition are (Kumar and Wu, 2011):

- rich and stable structure that is preserved since birth and is quite unique in individuals
- being invariable to the changes in pose and facial expression
- relatively immune to anxiety, privacy and hygiene problems

Human ear is highly curved 3D surface and therefore provides rich 3D features which can be used for exact feature selection and more precise person recognition. Using image processing when working with 3D images has proven to extract unique features which can"t be extracted from 3D images of other anatomical biometrics such as iris or fingerprint.

Whether the input is 2D or 3D image, it is processed to extract all the features as part of image processing and preparing input for any biometric system used for person recognition. These images are prepared for an ear biometric system.

The evolution of using person recognition based on person"s ears dates centuries back. In 1096, Richard Imhofer defined four different characteristics to distinguish 500 different persons by their ears (Imfoher, 1906). In 1949, Alfred Iannarelli determined 12 features needed for person recognition on 10000 different people (Imhofer, 1906). Iannarelli also discovered that ears are unique among twins, triplets and similar for relatives. Those discoveries made it clear that there are biometrical disadvantages of using ear for person recognition. However, studies in (Meijerman et al., 2004) and (Singh and Purkait, 2009) show by example that a person evolution, development and growth through years lead to possession of new individual characteristics. Those characteristics become unique features of the outer ear even for siblings.

There have been some questions and uncertainties about the accuracy of this modality in person recognition as standalone recognition mean. The Forensic Ear identification Project (FearID) was initiated by nine institutes from Italy, the UK and the Netherlands in 2006 (Alberink and Ruifrok, 2007). The study measured an Equal Error Rate (EER) of 4%. This error rate is satisfying even in forensics, which means that ear prints can be used as evidence in a semi-automated system. After this study, many systems implemented ear recognition as part of person recognition, but a minority of systems used it as a standalone solution, such as German police in their surveillance video analysis.

3. EAR RECOGNITION ALGORITHMS - STATE OF THE ART

During the evolution of the person recognition using ear as a biometric modality, many methods have been developed with different success on various test datasets. Main categorization could be done based on the input required for the algorithm. We can differentiate algorithms which use 2D or 3D images for recognition process.

3.1. 2D image recognition

In the list below, most of available works on 2D ear image based recognition are presented in chronological order (Pflug and Busch, 2012):

1. Burge and Burger (1998) Vornoi Distance Graphs
2. Hurley (2002) Force Field Transform
3. Moreno (2002) Geometric features with Compression Network
4. Yuizono (2002) Genetic Local Search
5. Victor (2002) PCA
6. Chang (2003) PCA
7. Abdel-Mottaleb and Zhou (2005) Modified Force Field Transform
8. Mu (2005) Geometrical measures on edge images
9. Abate (2006) General Fourier Descriptor
10. Lu (2006) Active Shape Model and PCA
11. Yuan (2006) Non-Negative Matrix Factorization
12. Yuan and Mu (2007) Full Space LDA with Outer Helix Feature Points
13. Arbab-Zavar (2007) SIFT points from ear model
14. Jedges and Mate (2007) Distorted Ear Model with feature points
15. Liu (2007) Edge-based features from different views
16. Nanni and Lumini (2007) Gabor Filters and SFFS
17. Rahman et al. (2007) Geometric Features
18. Sana (2007) Haar Wavelets and Hamming Distance
19. Arbab-Zavar and Nixon (2008) Log-Gabor Filters
20. Choras (2008) Geometry of ear outline
21. Dong and Mu (2008) Force Field Transform and NKFDA
22. Guo and Xu (2008) Local Binary Pattern and CNN
23. Nasseem (2008) Sparse representation
24. Wang et al. (2008) Haar Wavelets and Local Binary Patterns
25. Xie and Mu (2008) Locally Linear Embedding
26. Yaqubi (2008)HMAX and SVM
27. Zhang and Mu (2008) Geometrical Features, ICA and PCA with SVM
28. Badrinath and Gupta (2009) SIFT landmarks from ear model
29. Kisku (2009) SIFT from different Color Segments
30. Wang and Yuan (2009) Low-Order Moment Invariants
31. Alaraj (2010) PCA with MLFFNNs
32. Bustard (2010) SIFT Point Matches
33. De Marisco (2010) Partitioned Iterated Function System (PIFS)
34. Gutierrez (2010) MNN with Sugeno Measures and SCG
35. Wang (2010) Moment Invariants and BP Neural Network
36. Wang and Yuan (2010) Gabor Wavelets and GDA
37. Fooprateepsiri and Kurutach (2011) Trace and Fourier Transform
38. Prakash and Gupta (2011) SURF and NN classifier EER
39. Kumar (2011) SIFT GAR, FAR
40. Wang and Yan (2011) Local Binary Pattern and Wavelet Transform
41. Kumar and Wu (2011) Phase encoding with Log Gabor filters

The Force Field Transform by Hurley (2002) is one of the most frequently used methods for ear based recognition. This approach assumes mutual attraction of pixels that is proportional to their intensities and inverse to the square of the distance between them.

Structure of the outer ear proved to give extra information used for person recognition. Extraction of specific texture features can be extracted using Gabor filters. Wang and Yuan (2010) did it and then discriminately selected the most distinctive ones as they considered them to be the key information in the recognition. Kumar and Wu (2011) used Log-Gabor filters for extracting features of the local structure of the ear. Extracted features were stored in normalized grey level images. In their experiment, Log-Gabor based features had better performance than Hurley"s approach and landmark-based feature extraction approach.

Abate (2006) presented in his work generic Fourier descriptor for rotation and scale invariant feature representation. He used a polar coordinate system to transform the image into coordinates and then converted the coordinates into frequencies. The ear images had to be aligned in order to centralize the coordinate beginning before transformation into the polar coordinate system.

Wang (2010) composed six feature vectors with the help of seven moment invariants. The study showed that each of the moment invariants is invariant to changes in scale and rotation. The feature vectors were then set as input for a neural network for classification of the feature sets. Wang and Yuan (2010) then compared different feature extraction methods. They concluded that the complete accuracy of 100% is made by using moment invariants and Gabor transformation.

3.2. 3D image recognition

Recent papers focused more on 3D images in order to improve accuracy of the process. The strengths of 3D images are their immunity to rotation, scaling and translation. Shadows and special features discovered in a 3D image of an ear gave crucial addition to overall features used for person recognition. Usually, in the system where they bring more information than they take computational resources, 3D images can recognise a person based on their ear as a biometrical module only. Following algorithms gave significant results in this process:

1. Yan and Bowyer (2005) ICP using voxels
2. Chen and Bhanu (2005) ICP Contour Matching
3. Chen and Bannu (2007) Local Surface Patch
4. Liu (2007) Mesh PCA with neural network
5. Passalis (2007) Reference ear model with morphing
6. Yan and Bowyer (2007) ICP using Model Points
7. Cadavid (2008) ICP and Shape from shading
8. Islam et (2008) ICP with reduced meshes
9. Islam et (2008) Local Surface Features with ICP-Matching
10. Zheng (2010) Local Binary Patterns
11. Liu and Zhang (2011) Slice Curve Matching
12. Zhou (2011) Surface Patch Histogram and voxelization

Widely used method is ICP contour matching described in (Chen and Bannu, 2007). ICP requires double alignment of the models. They suggested extraction of point clouds from the ear contour and the registration of points with ICP (Chen, 2005).

Yan and Bowyer split the image of the ear and extracted features that give information about identity. In order to save computational resources in the recognition process, parts of the ear are indexed for faster ICP matching (Yan and Bowyer, 2005). That idea developed in direction of using Model Points in (Yan and Bowyer, 2007).

In (Cadavid, 2008) Cadavid presented a system suitable for video streaming and live image capturing, which can extract 3D models with the help of shading technique (Cadavid, Mahoor and Abdel-Mottaleb, 2009). 3D model is then set as an input in the system in order to be compared with the existing 3D images in the database.

All 3D algorithms mentioned in this paper present approaches that work satisfactorily with clear images and without occlusion. When introducing complexities such as earrings, hair etc. it has to be examined which algorithm might show best results.

4. ALGORITHMS COMPARISON

In this section of the paper we present the most important algorithms. Specifically, algorithms are presented chronologically and the way of their functioning is described briefly. 3D and 2D algorithms for ear feature extraction are separated and their advantages and disadvantages have been defined. Also, we presented recognition rates where provided by authors.

There are various research papers discussing about person recognition techniques based on human ear. Some of the papers present specific overview of algorithms used (Pflug and Busch, 2012), but none of them refers to recommendations for algorithm improvement in different segments. We believe that presenting most important algorithms for ear based person recognition and defining segments in which they can be used or improved makes room for future research in this area. In example, standardizing feature set which could lead to segmentation of ear in the recognition process. If the ear were segmented

into parts for examination, it would be possible to give significance or distinction to certain parts of the ear. Similarly, pose variations and occlusion might be partially solved by omitting occluded parts of the ear.

In case of 2D algorithms there are 5 which take precedence: Force Field Transform (Hurley, 2002), Fourier descriptor for rotation and scale invariant feature representation (Abate, 2006), Moment invariants with back propagated neural networks (Wang et al., 2010), Gabor filters (Wang and Yuan, 2010) and Local orientation features using even Gabor filters (Kumar and Wu, 2012).

Force Field Transform algorithm extracts wells and channels of the ear. It extracts a description based on the well position. It has been proven that these kind of descriptions are unique for every ear. Unfortunately, this approach has been tested on 9 subjects only, which is a setback. Room for upgrade of the algorithm could be increasing number of measures used for recognition. Additionally, by including channels into description better performance of the algorithm could be achieved. Advantages of this approach are that it is scaling invariant, it has high noise tolerance and there is no explicit ear topology description needed. No recognition rate of this algorithm has been presented by the authors.

Abate suggests Generic Fourier Descriptor for feature extraction. This algorithm is illumination and rotation invariant. Unfortunately, no testing or recognition rate information about this algorithm have been presented in the paper.

Wang, Xia and Wang recommend using improved moment invariants algorithm for feature extraction and then applying high order moment invariants for extracting 6 feature vectors. Good side of this algorithm is that it is invariant to translation, rotation and size change. By using BP neural network on 60 subjects data set, recognition of 91.8% was reached.

Gabor filter is robust and durable in case of illumination change, but Gabor features vector has immense dimensional space. Wang and Yuan use Gabor feature extraction and General Discriminant Analysis which effectively decreases dimensions of features vector. They have reached recognition rate of 99.1% on USTB database and also reported satisfying execution time - enough for real time system functioning.

Kumar and Wu achieved high performance as previous top approaches - eigen ear, force field transform, shape features. They reported recognition rate of 96.27% and 95.23% on databases containing 125 and 121 subjects, respectively. Authors used a pair of log-Gabor filters on IIT Delhi Ear Database. Disadvantage of this algorithm is that its performance has not been tested in different angles and occlusion. Testing has been done on a dataset that has small variation in image orientation and size. Thus, there is a need to test this algorithm in outdoor conditions in order to prove its performance. Outdoor conditions could greatly affect ear segmentation because of light changes and shadowing.

3D ear feature extraction algorithms that stand out are 3 algorithms presented in 2007. And 2008.

Contour matching (Chen and Bhanu, 2007) algorithm is based on contour of outer helix and uses ICP but it was improved to LSP since it has less feature points which made the process computationally cheaper. After the points were extracted, measured distances were compared to the existing ones in the database. The result was increase of recognition rate from 93.3% to 96.63% during an experiment with 302 subjects.

3D imaging (Yan and Bowyer, 2007) approach is based on contour function for describing ear shape and uses ICP with k–d tree data structure to efficiently search for closest point. The algorithm was evaluated in a large experimental study on 415 subject with accuracy rate of 97.8% and EER 1.2%.

ICP and Shape form shading (Cadavid, 2008) algorithm was presented by Cadavid as an algorithm that works well with real-time image extraction, where 3D images are modeled from CCTV images and shading technique for forming shape. Dissimilarities with existing images in the database is done by ICP. Downsides of this algorithm is its weak response to pose variations. Experiment with this algorithm on a 402 subject study showed 95% accuracy rate.

4. CONCLUSION

In this paper, there have been presented most of the available algorithms for ear based person recognition. The most important ones were applied on different databases and showed major success in accuracy. There is still a lot of room for improvement of various leading algorithms. Also,

In 2D images, pose variation and camera position change present a strong setback for most of the algorithms. Occlusion still remains the weakest link in ear based recognition. In this cases, it is indispensable to gather information about occluded parts. Occlusion caused by pose variations is especially neglected since there are no publications that tried to solve "filling the gaps" problem. There are feature extraction methods which partially solve pose variation disadvantages but they still have space for improvement.

Noticed shortcomings will be used in future works for ear based person recognition system improvement in terms of applying various algorithms in most suitable situations. Additionally, authors plan to explore possibilities for using only a visible portion of human ear in recognition process. This could be particularly useful in conditions of occlusion .

This approach might be used in all of the existing algorithms, in order to show proof of concept in improving accuracy. Also, This opens a possibility for using different algorithms on several parts of the ear.

ACKNOWLEDGMENTS

This work is a part of the project Multimodal biometry in identity management, funded by Ministry of Education and Science of Serbia, contract number TR-32013.

REFERENCES

A. Kumar, C. Wu, Automated human identification using ear imaging, Pattern Recognition (2011), doi:10.1016/j.patcog.2011.06.005

Abate AF, Nappi M, Riccio D, Ricciardi S. 'Ear Recognition by means of a Rotation Invariant Descriptor'. In: 18th International Conference on Pattern Recognition, ICPR 2006.. vol. 4; 2006. 437 –440.

Abaza, Ayman, et al. "A survey on ear biometrics." ACM computing surveys (CSUR) 45.2 (2013): 22.

Alberink I, Ruifrok A. 'Performance of the FearID earprint identification system'. Forensic Science International. 2007;166(2-3):145 – 154.

Cadavid S, Abdel-Mottaleb M. '3D ear modeling and recognition from video sequences using shape from shading'. In: 19th International Conference on Pattern Recognition (ICPR); 2008., 1 –4.

Cadavid S, Mahoor MH, Abdel-Mottaleb M. 'Multi-Modal Biometric Modeling and Recognition of the Human Face and Ear'. In: IEEE International Workshop on Safety, Security Rescue Robotics (SSRR); 2009., 1 –6.

Chen H, Bhanu B. 'Contour Matching for 3D Ear Recognition'. In: Proceedings of the Seventh IEEE Workshop on Applications of Computer Vision (WACV/MOTION); 2005.

Chen H, Bhanu B. 'Human Ear Recognition in 3D'. IEEE Transactions on Pattern Analysis and Machine Intelligence. 2007 April;29(4):718 –737.

F.J. Perales and B.A. Draper (Eds.): AMDO 2004, LNCS 3179, 51-61, 2004

Hurley DJ, Nixon MS, Carter JN. 'Force Field Energy Functionals for Image Feature Extraction'. Image and Vision Computing. 2002;20(5-6):311 – 317.

Imhofer R. 'Die Bedeutung der Ohrmuschel f¨ur die Feststellung der Identit¨at'. Archiv f¨ur die Kriminologie. 1906;26:150–163.

Islam SM, Davies R, Mian M A S an Bennamoun. 'A Fast and Fully Automatic Ear Recognition Approach Based on 3D Local Surface Features'. In: Proceedings of the 10th International Conference on Advanced Concepts for Intelligent Vision Systems. ACIVS '08. Berlin, Heidelberg: Springer-Verlag; 2008., 1081–1092.

Islam SMS, Bennamoun M, Mian AS, Davies R. 'A Fully Automatic Approach for Human Recognition from Profile Images Using 2D and 3D Ear Data'. In: Proceedings of 3DPVT - the Fourth International Symposium on 3D Data Processing, Visualization and Transmission; 2008.

Kumar A, Hanmandlu M, Kuldeep M, Gupta HM. 'Automatic Ear Detection for Online Biometric Applications'. In: Third National Conference on Computer Vision, Pattern Recognition, Image Processing and Graphics (NCVPRIPG); 2011., 146 –149.

Kumar A, Wu C. 'Automated human identification using ear imaging'. Pattern Recogn. 2012 March;45(3):956–968. Available from: http://dx.doi.org/10. 1016/j.patcog.2011.06.005.

Liu H, Zhang D. 'Fast 3D Point Cloud Ear Identification by Slice Curve Matching'. In: 3rd International Conference on Computer Research and Development (ICCRD); 2011., 224.

Meijerman L, Sholl S, Conti F. D, Giacon M, van der Lugt C, Drusini A, et al. 'Exploratory study on classification and individualisation of earprints'. Forensic Science International. 2004;140(1):91 – 99.
Passalis G, Kakadiaris IA, Theoharis T, Toderici G, Papaioannou T. 'Towards Fast 3D Ear Recognition For Real-Life Biometric Applications'. In: IEEE Conference on Advanced Video and Signal Based Surveillance (AVSS 2007); 2007., 39 –44.
Pflug A, Busch C 'Ear Biometrics: A Survey of Detection, Feature Extraction and Recognition Methods' IET Biometrics, 2012.
Robert Richardson, "2010/11 CSI Computer Crime and Security Survey". Computer Security Institute. 2011
Sana PPR Anupam; Gupta. 'Ear Biometrics: A New Approach'. In: Advances in Pattern Recognition; 2007
Singh P, Purkait R. 'Observations of external ear An Indian study'. HOMO - Journal of Comparative Human Biology. 2009;60(5):461 – 472. Available from: http://www.sciencedirect.com/science/article/pii/S0018442X09001164.
Starčević et al. "Multimodalna biometrija". Faculty of organizational sciences. 2014.
Wang X, Yuan W. 'Gabor Wavelets and General Discriminant Analysis for Ear Recognition'. In: 8th World Congress on Intelligent Control and Automation (WCICA); 2010., 6305.
Wang X, Yuan W. 'Human Ear recognition Based on Block Segmentation'. In: International Conference on Cyber-Enabled Distributed Computing and Knowledge Discovery (CyberC); 2009., 262 –266.
Wang Xq, Xia Hy, Wang Zl. 'The Research of Ear Identification Based On Improved Algorithm of Moment Invariants'. In: Third International Conference on Information and Computing (ICIC); 2010., 58
Wang Zq, Yan Xd. 'Multi-Scale Feature Extraction Algorithm of Ear Image'. In: International Conference on Electric Information and Control Engineering (ICEICE); 2011., 528.
Yan P, Bowyer KW. 'A Fast Algorithm for ICP-Based 3D Shape Biometrics'. In: Fourth IEEE Workshop on Automatic Identification Advanced Technologies; 2005., 213 – 218.
Yan P, Bowyer KW. 'Biometric Recognition Using 3D Ear Shape'. Pattern Analysis and Machine Intelligence. 2007 August; 29:1297 – 1308.
Yuan L, Mu Z. 'Ear Recognition Based on 2D Images'. In: First IEEE International Conference on Biometrics: Theory, Applications, and Systems (BTAS); 2007., 1 –5.
Zeng H, Dong JY, Mu ZC, Guo Y. 'Ear Recognition Based on 3D Keypoint Matching'. In: IEEE 10th International Conference on Signal Processing (ICSP); 2010., 1694.
Zhou J, Cadavid S, Abdel-Mottaleb M. 'A computationally Efficient Approach to 3D Ear Recognition Employing Local and Holistic Features'. In: IEEE Computer Society Conference on Computer Vision and Pattern Recognition Workshops (CVPRW); 2011., 98 –105.

PREVENTION OF FRAUD IN ELECTRONIC PAYMENT SYSTEMS

Marija Bogićević Sretenović, Jasna Petković , Bojan Jovanović
Fakultet Organizacionih Nauka
marija.bogicevic@fon.bg.ac.rs

***Abstract**: Nowadays, fraud is the leading problem in electronic payment systems. The subject of this paper is a review of existing techniques for prevention of fraud in electronic payment systems. Prevention and detection of fraud are of extreme importance in the field of risk management, as well as fraud management in payment cards industry. The end goal is to reduce the number of frauds through application of multidisciplinary approach. The system for prevention of payment card frauds is a complex system that collects knowledge from more than one source. This paper shows current condition throughout the world and gives a detailed comparison of modern techniques for prevention, detection and fraud management in electronic payment systems. The paper also gives an example of possible enhancements when it comes to prevention of frauds in electronic payment systems.*

***Key words**: fraud management systems, risk management, electronic payment systems, security*

1. Introduction

One of the main problems of electronic banking is to be found in the fact that fraud transactions are increasingly showing as genuine, that is, legitimate.

As for the historical development of fraud in electronic payment systems, it could be said that stealing and forgery of cards was present during the '70s, but the cards were then physically stolen. In '80s and '90s, ordering by telephone/mail became a common thing. Online fraud inhabited the world scene as the Internet went live worldwide and developed into something that allows for anonymity, availability and swiftness to commit fraud on world level.

One of the fastest ways of shopping is shopping with payment cards, where one gets the goods instantly, and pays for it later. Electronic payment systems have a series of advantages, such as ordering products from far away, which allows for consumers' conformity. However, there are disadvantages as well, such as security of data being transferred and exposure to risk of compromising data. Therefore, credit cards fraud is a serious problem encountered by all participants in this communication chain.

Today, most people use e-commerce partly due to economic reasons, and partly for conformity reasons, because there's no need to leave home. However, card fraud is quite a serious problem indeed. Every year, card issuing organizations and the consumers themselves are exposed to significant financial costs, and potential loss of incomes. It is very difficult to cope with some techniques used by fraudsters, since some of the methods being used for authorization are genuinely wrong and inadequate. In most number of cases, the buyer himself is not aware of the process taking place in the system after he/she buys a certain product. Earlier, at time when cards with magnetic strips were used, the salesman was able to compare the signature on the slip with the signature on the back of the card. However, in case the card was stolen, the fraudster was most likely to practice the signature so that the comparison was no longer of any use. In that case, one could introduce even higher level of prevention and ask for an additional document that would confirm the identity of a person, such as ID card or driver's license. Even higher level that was introduced later was the PIN entry, which makes the user signature unnecessary. In case of frauds, when the card is not physically present, various methods are used in an attempt to gain necessary data.The more the card is used for online shopping, the more it is exposed to attacks and compromising. In some regions, one of the methods used by fraudsters is learning the social security numbers by using social engineering techniques, and this number is used to additionally determine the person's identity.

Banks are highly interested in processor speed that helps in detecting a fraud. Any activity can jeopardize the cardholder, and the banking institution itself. This could be either the bank in which the owner has an account tied for a card, or a processing company that supports the bank. Institutions mainly combine basic forms of prevention with more complex ones, and thus they form what is known as Fraud Management. Fraud technologies encounter the possibilities of active survey of an account in order to discover or at least sense all irregularities in transactions.

From the financial point of view, if we are to observe frauds, it's like a recursive life cycle that illustrates a continual response to fraudsters' behavior. Ever changing trends in the fraud development eventually led to the point where the systems are being continually developed and complex algorithms are constantly applied,

such as data mining and data analysis. The goal is to design new security protocols, as well as authentication protocols. In their response to these innovations, fraudsters develop new techniques that are to help them overcome these protective measures. New fraud patterns are identified as a result of security enhancements, including the development of new software solutions, or to be more precise, through stronger authentication and safety procedures.

2. FINANCIAL LOSSES OVER CARD FRAUD WORLDWIDE

Card fraud is becoming widely spread phenomena, which is supported by following statistical data. Namely, in 2012 alone, the abuse of credit and debit cards has caused a $ 11.7 billion loss worldwide. In the same year, the greatest number of fraudulent financial transactions over cards hit 47.3pct out of overall global transactions. Compared to 2010, up to 67pct of those exposed to frauds were the US citizens (Lindsay, 2014).

Table 1. shows regional losses caused by card frauds, where the P – predicted indicates predicted losses. Table helps us drawing a conclusion that the losses are immense, and that the prevention of fraud in electronic payment system is a problem that needs to be handled in a systematic manner.

Table 1: Regional forecast of spending and losses (Riley, 2012)

Regional spending in millions USD	2011	2012	2013	2014	2015	2016P	Annual growth
North America	$794	$794	$799	$800	$806	$816	0,5%
Europe	$444	$453	$460	$463	$465	$466	1%
Asia Pacific	$379	$416	$455	$491	$528	$564	8,3%
Latin America and the Caribbean	$98	$106	$114	$122	$130	$137	7%
Middle East and Africa	$31	$33	$34	$35	$36	$36	3,2%

2.1 Types of Fraud

According to the report of Aite Group from 2010, the frauds could be classified as follows:

1. *first-party fraud*
2. CNP (Card-not-Present)
3. counterfeit card – creating fake cards
4. lost and stolen cards
5. mail non-receipt fraud
6. card number theft / Identity theft

Figure 1. shows down the fraud losses by category according to Aite Group (Aite Group, 2012). This research has shown that the United States suffered greatest gross financial losses in 2008. CNP fraud represents the weakest spot for merchants. CNP fraud is growing faster than counterfeit fraud. Figure 1. shows that the First-party fraud is taking the greatest portion in this classification.

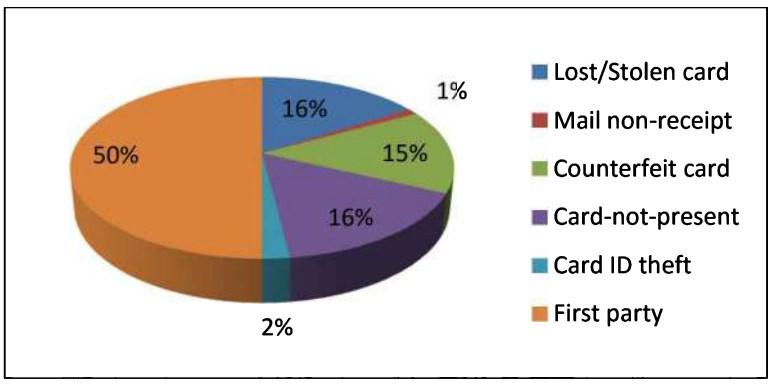


Figure 1: Portion of certain fraud types in 2012
(Aite Group, 2012)

2.2 The greatest attacks in the history of fraud management

Great attacks that happened over the last ten years, when this problem became real serious, speak of the importance of preventing credit card frauds. From July, 2005 to August, 2007, the attacks on the systems in TJX Company have exposed more than 46.5 million card details (Jones, 2013). Albert Gonzalez has been

accused of being a chief hacker who organized a group that carried out the attack. It is believed that Gonzalez, together with ten more associates, carried out this attack by using wireless scanners to find stores with vulnerable networks and them captured account information.

In August 2009, Gonzalez was again a main suspect for card fraud, or in this case, over 130 million cards that were stolen in Heartland Payment Systems, retailers 7-Eleven and Hannaford Brothers, and two unidentified companies (Godin, 2009).

In most number of cases, once the perpetrators obtained credit card data or the card itself, they pulled the money from victim's account in as short period of time as possible. This was one of the biggest ID theft case in the United States of America. The attack was carried out by using SQL injection to install sniffer software on the Heartland Payments System server to collect and intercept credit card data. This attack was a big disgrace and it hurt company's reputation badly, since the company processed more than 100 million transactions a month for more than 250.000 merchants.

In 2012, over 40 million cards have been compromised by hacking the Adobe Systems. The fact is that the total global payment-card fraud losses were $ 11.3 billion in 2012, up nearly 15% from the prior year (Economist, 2014). The United States is one of rare countries in which counterfeit-card fraud is consistently growing. Based on this, card issuers lost $ 3.4 billion in 2012 and merchants another $ 1.9 billion.

At the end of 2013 there were 1.2 billion debit, credit and pre-paid cards in circulation in America, which is more than in any other region in the world. That is nearly five cards per adult. As of 2012, 45pct of the world's payment cards and 76pct of terminals were equipped to use chip-and-PIN.

Already in July 2013, a new attack happened, and it was recorded as the 'largest hacking and data breach scheme ever prosecuted in the United States' (Benson, 2013). Russians and Ukrainians were involved in this case that took place in New Jersey, and which exposed more than 160 million credit card numbers. Those card numbers were later used for printing new plastic cards that were used for shopping. This attack resulted in hundreds of millions of dollars of losses.

Between November 27, 2013 and December 15, 2013 around 40 million cards were affected, including the cardowner name, account number, expiration date, and CVV (card verification value). The hackers hit Target Corporation, and estimates say that almost 70 million Target customers suffered losses due to this attack.

A newer attack occurred between July 16, 2013 and October 30, 2013 with Neiman-Marcus hit with a breach, when around a million of card numbers were found in their system (Wagenseil, 2014).

Recently, some banks in Indiana were also under attack. The hackers obtained card information from ATMs or through debit card payment, where more than 100 users were exposed. Transactions ranging from several hundreds to several thousands of dollars took place in Nigeria, Russia, Ukraine and Spain. A lot of cases were reported on behalf of Citibank the same year, where only two men executed hundreds of transactions and pulled around $ 750.000 from ATMs in New York. The target was a data server in Citibank. From 2007, FTC has recorded over 800,000 exposed users with total fraud loss of over $ 1.2 milliard.

In 2012, a new attack hit the payment processor company Global Payments, which resulted in exposure of 1 million cards. Visa and MasterCard payment systems were the target, and it was suspected that magnetic stripes, stripe 1 and stripe 2 were compromised. In May 2012, it became obvious that the hackers moved from Great Britain to France and Germany due to introduction of EMV in GB.

In the course of 2013, there was a great number of data breaches, when hackers used all of their abilities to take advantage of system malfunctions, as was the case with Target and Neiman-Marcus.

3. TECHNIQUES FOR PREVENTION OF PAYMENT CARD FRAUD

The development of new techniques for revealing payment card frauds is complex, mainly because of the limitations in exchange of ideas and information in this field. Once the details on fraud techniques are made public, persons in charge of the breach can use this information to avoid exposure, but at the same time these details are used for enhancing future breach techniques, by using current system faults. Set of data necessary for any of the fraud techniques is not available in public.

Techniques for fraud prevention could be classified in different ways, and one of them is as follows:

1. application of basic set of rules

2. implementation of EMV standards
3. use of complex security protocols
4. use of smart tools for prevention and detection.

3.1 Comparative analysis of fraud prevention techniques

Table 2. shows evaluation of fraud prevention techniques taking into account general and conceptual features of some techniques such as AVS, CVV2, Manual review, Negative & Positive list, Trusted e-mail, and biometrics (Bogicevic, 2014). These techniques have been compared for following characteristics: are they user friendly, are they easy for implementation, how fast are they, what's their price, is the service being charged, does it require a change in system if implemented, does it secure fraud reduction, and how realistic is to expect this technique to be applied. They came to a conclusion that the most user friendly techniques are AVS, CVV2, Negative&Positive list, authentication, and trusted e-mail. Biometrics, on the other hand, is not easy for implementation, which makes it expensive for realization. Unlike biometrics, AVS and CVV2 are fast and inexpensive techniques that make only slight changes in the system once being implemented. Buyer authentication, trusted e-mail and biometrics are most efficient when it comes to fraud reduction.

Table 2: Evaluation of fraud prevention techniques (Al-Furiah, 2009)

		Evaluation of techniques						
FEATURES		**AVS**	**CVV2**	**Manual Review**	**Negative& Positive list**	**Buyer authentication**	**Trusted e-mail**	**Biometrics**
General	**User friendly**	H	H	M	H	H	H	M
	Simple for implementation	H	H	M	H	H	H	L
	Speed	H	H	L	M	H	H	M
	Price	L	L	M	M	M	L	H
Conceptual	**Service payment**	M	M	NI	NE	H	H	H
	Requires change in the system	L	L	L	M	M	L	H
	Fraud prevention	M	M	L	L	H	H	H
	Real process time	H	H	NE	Hor NE	H	H	H

High -H, Medium -M, Low - L, Not indicated -NI, Not existing –NE

Table 3. displays advantages and disadvantages of following fraud prevention techniques: AVS, CVV2, *Manual review,* Negative&Positive list, Buyer authentication, *trusted e-mail,* Biometrics.

Table 3: Advantages and disadvantages of fraud prevention techniques (Al-Furiah, 2009)

Techniques	Advantages	Disadvantages
AVS	- simple, fast and easy for implementation - reduces fraud risk - AVS helps merchants to charge the service - there's no additional cost because AVS could be requested as a part of authorization	- In some cases, buyer's valid address differs from the one reported on the occasion of card issuing - It is not a perfect indicator of a fraud - AVS is not effective for *soft* products
CVV2	- Reduces *CNP fraud* - Prevents card counterfeit - No additional costs - Reduces costs induced by fraud	- Not applicable with stolen and lost cards - The hacker can obtain CVV2 values through system breach
Manual Review	- It's most useful when used with other techniques	- Not an effective technique for fraud prevention - Work quality depends on employees' experience and feedback - It's a very expensive and time-consuming method
Negative& Positive list	- It's a basic technique that serves as a starting point for further considerations - User friendly - Negative list is good for fraud reduction	- It cannot prevent the fraud – card number theft - Frequent updating is a must

	- Positive list decreases time needed for checking the valid order	
Buyer authentication	- It's a starting tool that secures protection of merchants from additional fraud-induced costs - Associations provide this technique in order to make buyers use online shopping - Total cost is low - Responsibility for costs is against the buyer	- Only Visa and Master cardholders can use this service - Buyers don't like this technique since it's time-consuming
Trusted e-mail	- It's an effective technique that helps in merchants' protection and cutting costs - Simple for implementation and use - Better than any other method that uses the delivery address or a verification code - Low price - Requires minimum amendments for all participants in e-payment - Doesn't stand in a way of other solutions	- No fault discovered yet
Biometrics	-Very efficient technique for authentication of buyer identity	- Hard for implementation - Expensive - Requires plenty of changes

4. ALGORHITMS FOR DETECTION OF PAYMENT CARDS FRAUD

Hackers use all possible ways to take advantage of some part of the communication chain between the entities, and thus gain data through payment cards use. The only logical solution is prevention and implementation of all the techniques in order to prevent fraud. There are numerous techniques for fraud prevention, and at the same time, those techniques are being enhanced as we speak (Kou, 2004).

Fraud detection is a very complex IT problem, and there's definitely no system that could predict with certainty which type of fraud is going to take place. There are basic rules that could be implemented and applied by Fraud Management Systems (FMS), but sometimes even they are not enough. For that reason, complex algorithms for reviewing and predicting transactions are being used, and they are supposed to tell us whether the transactions are genuine or fraudulent. Those complex algorithms are working on a principle of predicting the possibility of an event, and in this case the event is whether it's a fraud transaction or not. Techniques for prevention and detection are supposed to reduce the number of frauds, and they are a key part of risk management in banking sector, especially when it comes to electronic payment systems. Prevention techniques comprise a series of basic rules, and when that rules fail in preventing a fraud, detection techniques are being applied.

Given that there's a difference between online and offline frauds, we can also distinguish online and offline monitoring in FMS. Different techniques could be used for different kinds of frauds. FMS are to provide next conditions:

1. to detect fraud in early stage and with sharp precision.
2. to provide relevant information to fraud analysts in timely manner.
3. a good system shouldn't detect genuine transaction as a fraudulent transaction.
4. to make this process automatized wherever applicable.
5. to self-adapt to changes in fraud patterns.
6. to self-adapt to changes in consumers' behavior.

Techniques for prevention and detection could be implemented on behalf of the issuer, and also on behalf of the acquirer, but the main difference is that the suspicious transaction is mostly rejected by issuer.

These are the most often used algorithms for detection of card fraud (Zareapoor, 2012):

1. A Hybrid Approach using Dempspter-Shafer Theory and Bayesian Theory
2. Blast-Ssaha Hybridization
3. Hidden Markov Model
4. Neural network

5. Bayesian Network
6. Genetic Algorithm
7. Artificial Immune System
8. K-nearest neighbor algorithm
9. Support Vector Machine
10. Decision Tree
11. Fuzzy Logic Based System
12. Meta Learning Strategy

5. RISK MANAGEMENT

Risk and uncertainty are two key terms when it comes to decision making in any institution whatsoever, and especially in banking institutions that are of special importance for this paper. The probability is the measure of randomly selected uncertainty and statistical models, used to calculate statistical risk. Financial risk could be defined as a measure of uncertainty that the buyer is ready to accept while performing financial transaction. This kind of risk is associated with payment systems and credit options offered to consumers. In the very beginning of e-commerce development, the financial risk mostly referred to those articles that hold lower degree of risk, such as books, music, clothes, and journeys. In general, prices of products are more often viewed in offline shopping mode than in case of online transactions, which carries greater risk for this kind of shopping. Newer researches show that the financial risk depends on the user age, gender, education, and marital status.

For calculating any kind of risk, a math formula, the so-called ratio is being used for creating complex models that calculate more than one ratio and their mutual dependence. Operative risk is dealing with financial transactions and all consequential events. As for the operative risk and frauds in financial transactions, banks in Serbia lack models for that kind of risk, because it is believed that the fraud level is quite low. Therefore, the risk is being regulated by introducing standards, as well as all the methods for prevention and detection of algorithms, which are described in previous chapters of this paper. The most important thing is that all events that cause some kind of fraud are reviewed under operational risk and they are given a certain ponder – it is only important to recognize and define all the events that could happen.

Banks face different types of risks, such as credit risk, market and operational risk (Li, 2013). These risks were originally managed and measured separately. However, this limit moved in time so that in 2007, when the crisis started, it was realized that these risks interact with each other and are inseparable. Banks develop quantitative risk measures that are applicable to all types of risk.

By using different methods, financial analysts create financial data available for operational risk as one of the types of financial risk, and in this way, statistical models could be applicable on operational risk. Many large banks have already started with collecting data on losses and loss measurement through operational risk. Most of them have limited time series, but in spiteof fewer number of data regarding great losses, they represent a mandatory model.

If we are to observe operations of a banking institution, we can see that the credit risk accounts with 60pct, operational risk with 30pct, and the rest goes for market risk – 10pct.

The model of operational risk is a set of functions that represents uncertain future events. The uncertainty could be the occurrence of an event, the time of occurrence, as well as the amount of loss caused by an event (Kim, 2008). The uncertainty could be represented through probability, and therefore, the model of operational risk measurement is actually the probability model.

One of the models of measuring operational risk is the Advanced Measurement Approach-AMA (BIS, 2011).

6. SOLUTION PROPOSAL

Figure 2. shows solution architecture in case when the bank as a card issuer entrusts the service of transaction processing to Processor Company, while checking if the transaction is fraud or not is entrusted to a solution proposed in this paper. The solution proposal is also given for cases when the ATM, POS and Internet transaction (through payment gateway to the bank) are initiated on bank's devices.The cards of bank the issuer could be used on these devices, as well as cards of other bank issuers.

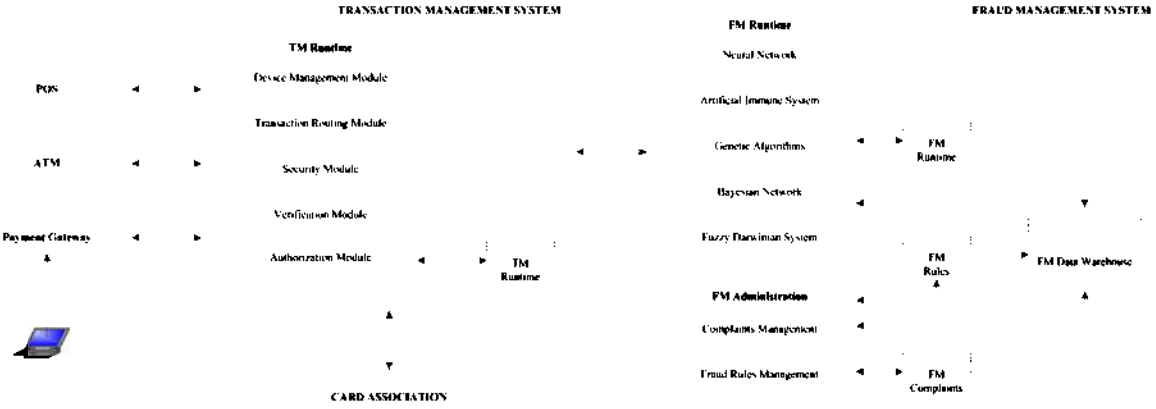


Figure 2: Architecture and software modules of proposed Fraud Management System

System components:

I Transaction Management System – TMS

1. Transaction management Runtime
   - This is a part of TMS that contains several modules that process transaction in real-time mode.
2. Device management module
   - It determines the type of the device on which the transaction is being carried out (ATM / POS/ Internet, i.e. payment gateway) and transcripts it to adequate format required for TMS.
3. Transaction Routing Module
   - Through BIN (Bank Identification Number) it determines to which bank the transaction belongs to,
   - Carries out validation of certain fields, transaction parsing.
4. Security module
   - Runs a check on PIN and decrypts encrypted elements of transaction message
5. Verification module
   - Validation of card validity, among other things, checking card expiration date
6. Authorization module
   - Checking if there's enough money on the account and authorizes the transaction
7. TM Runtime Database
   - All transaction that take place, either fraud or genuine ones, are stored in this base
   - Transactions that have been rejected in some of the modules TM Runtime are also stored.

II Fraud Management System

1. FM Runtime module
   - This module defines algorithms for detection of frauds, including Bayesian Network, Neural Network, Artificial Immune Systems, Genetic Algorithm, and Fuzzy-Darvin algorithm. These algorithms detect whether the transaction is fraud or not, because they implement defined rules within DB rules.
2. Fraud management runtime database
   - This is operating data base used by FM RT module, and which contains all data concerning the transactions that took place.
3. Fraud management data warehouse database
   - This is a DW database that helps in making decisions and serves for displaying statistical data and more detailed consideration of card owner behavior, which eventually leads to making a decision on whether the transaction is fraud or not.
4. Fraud management administration
   - This GUI can change parameters and introduce new rules in FM rules, or make new decisions on transactions based on information obtained by FM Complaints.
5. FM Rules database

- This base holds all the rules defined for fraud prevention, and in case of non-compliance with those rules the transaction is considered to be illegitimate, and this raises the alarm level. The values of parameters for those rules are defined in here.
- Visa's rules are adjusted to bank's needs
- General rules:
    - Tied to transaction location
    - If it's an Internet transaction, attention is paid to IP address
    - What's the time scope between two transactions
    - Type of account being used

- Control rules:
    - What's the BIN
    - What's the amount of transaction
    - Values for AVS, CVV – for cards with magnetic stripe, CVV2, PAN
    - User's limits
- Rules for operational risk measurement where we can monitor:
    - Risk given the territory of transaction initiation
    - Risk for merchants' activities
    - Risk given the financial effect.

6. FM Complaints database
    - In case some transaction left the system as being valid, and it turns out that there was a system error, i.e. it's a fraudulent transaction not recognized by the system, it is necessary to enter corrections into FM DW.

III Card Association

1. These are card organizations, which, in a solution presented in this paper, receive transactions from TMS, initiated by a payment card which is not issued by a bank that is in ownership of one of those devices (ATM, POS), and process them.
2. Card organizations are as follows:
    - VISA
    - MasterCard
    - Diners.

Steps with transaction processing:

1. Transaction is initiated by a device (ATM, POS, Internet transaction)
2. DMM determines the origin of the device and transcripts it to adequate TMS format.
3. After that, TRM determines the bank in question based on BIN, and if it's on-us (transaction from the card issued by a bank – issuer for which the processing activities are being done), it sends the transaction in FMS to check if it's genuine or fraudulent. In opposite, if the transaction is done with a card that belongs to a bank whose processing activities are not carried out by our processor, the transaction is sent out to Card organization for further check.
4. Once the transaction reached FMS, based on rules defined in FM Rules, FM Runtime processes a transaction by using an algorithm for fraud detection, and places executed transactions into FM Runtime operational base.
5. Upon the executed transaction, FM Data Warehouse is being loaded in real time, and updated with information from FM Complaints.
6. Based on all input streams, including reading rules from FM Rules, data Warehouse provides different types of reports which helps FM administration to change users' and system rules, and at the same time solves the problem of suspicious transactions in FM Complaints.
7. After the transaction is processed, FMS provides either positive or negative reply.
8. In case the replay was positive, the transaction is being sent for further processing to SM, together with all the necessary fields.
9. After that it is being forwarded to VM.
10. AM authorizes the transaction, or to be more precise, it checks whether there's enough money on user's account and then sends the response back to user in the form of successfully or unsuccessfully processed transaction. At the same time, it is updating TM Runtime database.

7. CONCLUSION

Over the years, we were the witnesses of greater use of electronic payment systems, but also of the attached risks. Just the same, payment cards are more and more used for shopping, while cash is used less, and the reason for this is to be found in a fact that people grow trust in the safety of these systems. Fraud systems and thefts are developing, but security measures for protection against fraud are getting better and up-to-date.

One of the directions of future research is the selection of complex algorithms that are best to be applied for modeling Fraud Management System that will be grounded on several algorithms. This FMS will apply positive features of every respective algorithm, and at the same time, it will try to eliminate their faults. On the other hand, back in the past biometrics was almost in the field of science fiction when it comes to e-commerce, while today this is something that is real and widely spread. Today, finger scanning is the most commonly used technique for determining the user identity. However, iris scanning is the future of electronic payment systems, with an aim to reduce frauds and financial losses, thus increasing the level of security.

ACKNOWLEDGMENTS

This paper is part of the project 'Multimodal biometry in Identity Management', funded by the Ministry of Science and Technological Development of Serbia, number of contract TR-32013.

REFERENCE

Aite Group (2012). Card Fraud in the United States: The Case for Encryption.

Al-Furiah, S., & Al-Braheem, L. (2009). Comprehensive study on methods of fraud prevention in credit card e-payement system, Procedings of iiWAS.

Benson, C. (2013). Russian hackers charged in biggest data breach case, 160mn credit card numbers stolen, Reuters, preuzeto sa http://rt.com/news/us-hacking-ring-charged-587/

BIS (2011). Bank for International Settlement, Basel Committee on Banking Supervision Operational Risk-Supervisory Guidelines for the Advanced Measurement Approaches, preuzeto sa http://www.bis.org/publ/bcbs196.pdf

Bogicevic, M., Milenkovic, I., & Simic, D. (2014). "Identity Management – A Survey", Palgrave Macmillan, Innovative Management and Firm Performance - An Interdisciplinary Approach, ISBN 9781137402226.

Economist (2014).The Economist, Skimming Off the Top: Why America has such a high rate of payment-card fraud, preuzeto sa http://www.businessinsider.com/why-america-has-such-a-high-rate-of-payment-card-fraud-2014-2

Godin, D. (2009). TJX suspect indicted in Heartland, Hannafors breaches, preuzeto sa http://www.theregister.co.uk/2009/08/17/heartland_payment_suspect/.

Jones, D., & Finkle, J.F. (2013). Largest Case Launched After Credit Card Info Stolen From J.C.Penney, Visa Licensee, preuzeto sa http://www.huffingtonpost.com/2013/07/25/credit-card-stolen-visa_n_3653274.html.

Kim, Y., Savoldi, A., Lee, H.,Yun, S., Lee, S., & Lim, J. (2008). Design and Implementation of a Tool to Detect Accounting Frauds, IEEE Computer Society, DOI 10.1109/IIH-MSP.2008.257.

Kou, Y., Lu, C., Sinvongwattana, S., & Huang, Y. (2004). Survey of Fraud Detection Techniques, Proceedinges of the 2004, IEEE, International Conference on Networking, Sensing and Control.

Li, J., Zhu, X., Lee, C.F., Wu, D., Feng, J., & Shi, Y. (2013). On the aggregation of credit, market and operational risks, Springer, DOI 10.1007/s11156-013-0426-0.

Lindsay (2014). America leading the world in credit card fraud, preuzeto sa http://www.nerdwallet.com/blog/current-events/america-leads-world-credit-card-fraud/

Riley, B. (2012). Card Fraud Management Systems, CEB TowerGroup , preuzeto sa http://www.fico.com/en/wp-content/secure_upload/Card_Fraud_FICO_CEB_TowerGroup.pdf

Wagenseil, P. (2014). Neiman Marcus Data Breach FAQ: What to Do Now, Tom's guide, preuzeto sa http://www.tomsguide.com/us/target-neiman-marcus-data-breach-faq,news-18199.html.

Zareapoor, M., Seeja, K.R., & Alam, M.A. (2012) Analysis of Credit Card Fraud Detection Techniques: based on Certain Design Criteria, International Journal of Computer Applications, volume 52, issue 3.

CASH, HASH OR TRASH - HASH FUNCTION IMPACT ON SYSTEM SECURITY

Milos Zivadinovic[1], Ivan Milenkovic[1], Dejan Simic[1]
[1]Faculty of Organizational Sciences, Belgrade, Serbia
mzdv@outlook.com, ivan.milenkovic@fon.bg.ac.rs, dsimic@fon.bg.ac.rs

Abstract: *Authentication methods present an important part of every secure system. Traditional, but still dominant authentication method is the authentication by password. In order to be evaluated, passwords have to be stored on the system. Usually, stored passphrases are protected by the use of the hash functions. The goal of this paper was to test vulnerability of commonly used hashing algorithms to password recovery attacks. Hashcat and oclHashcat utilities were used to generate password hashes. The experiment results are given, and reveal potential weaknesses in some of the algorithms.*

Keywords*: hash functions, authentication, password security*

1. INTRODUCTION

A chain is as strong as its weakest link, says the proverb. Data security presents one of the cornerstones of modern business. As the amount of data generated and consumed by a business exceeds all expectations, our processes applied to securing it must become more resilient. Identity management within an organization must be organized utmost care. An important part of the identity management process is the activity of authentication (Milenkovic, Sosevic and Simic, 2012). As passwords are still a common authentication method used today, there is a need for their secure storage. Application of hashing functions to the domain of data security becomes more of a reality due to the increase of computation power, but it comes with a cost: users have to be more aware of the authentication tokens they are using.

With that in mind, users are quickly becoming the weakest link due to the fact that they are predictable and follow specific patterns in their lives, both conscious and subconscious. This allows us to easily “break the chain” and become one step closer to accessing unauthorized data by generating a large number of hashed words and then comparing them with the actual hashed data containing user authentication tokens (e.g. passwords).

This paper tests two popular password recovery tools on a real world scenario. A standard laptop with an Intel I5 processor and a dedicated graphic card is used for the experiment. Tested algorithms were MD5, SHA 512 and BCrypt. Section 2 of paper describes the problem statement in more details. In section 3 hash functions analyzed are described in more details. Password recovery solutions used are described in Section 4. Experiment results are given in Section 5, and they are followed by conclusions in Section 6.

2. PROBLEM STATEMENT

A hash function is a function that maps an arbitrary length input to a fixed sized length message (Andreeva, Mennink and Preneel, 2015). Ideally, the mapping of data from the original set to the data from the hashed set should be bijective - one element from the original set should correspond to one element in the hashed set. According to that definition, authentication of users becomes simpler since we do not need to handle the original access token, just its hashed representation which is then compared to the stored value.

With the improvement of technology and processing power, most prominently in the GPGPU and ASIC components, previous hash functions that were deemed secure in terms of collision, become compromised. Furthermore, the usage of processing power allows us to generate large amounts of hashes in a relatively short time, thus creating our comparison set upon which we can deduce the original authentication token. This process allows us to easily discover unsafe authentication passwords, such as short passwords or passwords without a large number of possible characters (e.g. plain numeric passwords such as dates of birth) even with continuous auditing with tools such as Seraphim (Zivadinovic, Milenkovic and Simic (2014)).

What is the best way to secure our data, our identities and our means of authentication in this highly competitive environment? There are two paths that provide answers to this question. One of them is to

rapidly improve and implement new kinds of hashing functions or to improve the ones that currently exist. This can become troublesome and problematic due to the nature of hash functions and mathematical foundations which is out of this paper's scope. The other path presents the possibility of improving hash function performance in securing our identities and data by increasing the entropy of available characters used for the creation of our authentication tokens which are then hashed for comparison. Furthermore, this process allows us to drastically improve our system's security with zero infrastructure changes and minimal interventions from the users of the system, thus reducing costs both in training and infrastructure and in technical debt.

3. HASH FUNCTIONS

In general, the output of a hash function can be considered as a data "fingerprint". An important definition concerning hash functions is the definition of an "ideal" hash function. An ideal hash function maps inputs of arbitrary length to outputs of finite length, where the distribution of the outputs is uniform over a given range space (Maurer, Renner, Holenstein, 2004). The mapping should follow the principle of a random oracle, as the mapping function is perceived as a black box. The definition of an ideal hash function is mainly important because real world examples are evaluated on their differences from the ideal case.

In practice, each hash function is characterized by following attributes: collision, preimage security and second preimage (Merkle, 1979). Collisions describe situation where two different inputs produce a same output value. Preimage security is connected to the following scenario, how hard is for a potential attacker to guess which input was used to generate a known output. In second preimage attack, we have a known input. The attacker goal is to find another input which gives the identical hash value as the known input.

MD5 is a cryptographic hash function which creates a 128 bit hash value. It was introduced in 1992 by Ron Rivest as a replacement for MD4 algorithm (Rivest, 1991). Today, MD5 is not considered a very secure algorithm, as it has several deficiencies. As first, MD5 is prone to collision attacks. In (Dobbertin, 1996), H. Dobbertin provided an example of pseudo collision for MD5. (Stevens, et al) presented construction of two public certificates. Although certificates had different public keys, the MD5 hash value was the same. In (Xie and Feng, 2010) first single block MD5 collision was published.

All of the attacks described above exploit either the collision or second preimage. As a consequence, a password hashes created with MD5 should be secure against a first preimage attack. Unfortunately, MD5 algorithm is very fast, and does not require a great amount of memory space for execution. Therefore, brute force and dictionary attacks can be a threat for MD5 password hashes. These treats are relevant, as it is still possible to find MD5 used in different applications (Silent Signal Techblog, 2015).

SHA-512 and SHA-256 (*Secure Hash Algorithm*) belong to family of SHA-2 algorithms, designed by National Security Agency (NSA). Difference between SHA-256 and SHA-512 is in the size of blocks used. SHA-512 uses 64 bit words, while SHA - 256 uses 32-bit words.SHA-512 is in literature considered cryptographically secure, as best attempts at breaking preimage resistance have succeeded at 57 out of 80 rounds of SHA-2 algorithm (Khovratovich, Rechberger, Savelieva, 2012).

BCrypt is hash function based on Blowfish cipher (Provos, Mazieres, 1999). It can be adapted in order to increase computational complexity, so it has an increased resistance against brute force attacks. BCrypt is used for hashing user passwords in BSD and SUSE Linux.

4. PASSWORD RECOVERY SOLUTIONS - HASHCAT, OCLHASHCAT, JOHN THE RIPPER

Hashcat is a popular CPU based password recovery utility. It is available on *Linux/Unix*, *Windows* and *OS X* operating systems. *Hashcat* works with more than 150 algorithms and focuses on high performance. Command line is used as a control interface. Support for multiple cores is included, and *Hashcat* also allows distributed cracking. *Hashcat* allows creating different types of rules to combine dictionary and brute force attacks, needed to defeat highly iterated modern hashes. Although it was closed source for most of its history, the author of *Hashcat* has recently moved the source code to open domain.

oclHashcat uses GPU for password recovery computations. Currently, it is fastest publicly available password cracker. It supports the use of up to 128 GPUs simultaneously. As for the hardware support, all CUDA and Stream enabled cards should be compatible with oclHashcat. Simple dictionary attacks are supported (such as combinator attack), together with brute force and mask attacks. A major feature of oclHashcat is the GPU based rule engine (oclHashcat, 2016). Sometimes, copying the wordlist for dictionary

attacks can have a significant impact on performance. Using GPU rule engine, it is possible to copy a relatively small wordlist to the GPU memory and then increase it size.

Hashcat, together with *oclHashcat* was used by team *Hashcat* for several victories in row on CMIYC (*Crack Me If You Can*) contests (Korelogic Security, 2016). For example, some of the competition themes were the ability to create wordlists based on certain categories, passphrases, creating custom rules based on cracks and cracking passphrase which use non standard character encodings.

John the ripper is an another popular password cracker. It is available on several different platforms, such as *Linux, BSD, Solaris, Windows*, etc. Basic version is somewhat limited in number of supported algorithms, but community enhanced version gives access to a wider array of available algorithms, such as raw MD5 and salted SHA-512. *John the Ripper* offers some GPU support, but when compared to *oclHashcat* it is more of an experimental feature. It has some advantages over CPU based *Hashcat*, such as preprocessor, which generates multiple rules for a single source line. However, superior speed and functionalities of *oclHashcat* make this tool somewhat lacking.

5. EXPERIMENT

Experiment consisted of performing twelve iterations of brute-force attacks on above hashing algorithms, with the final goal of determining if the GPU provides advantages in figuring out very strong passwords and how the algorithms above perform when they are applied in the creation of a very large number of hashes. The passwords chosen as an example during the experiment, where every password was regenerated for the next iteration, consisted of eight alphanumeric characters, including upper and lower case letters. This was determined to be the best-practice password pattern advised by security experts due to the amount of entropy generated by the number of possible characters and the password length.

The experiment was performed under the *Ubuntu 14.04* GNU/Linux operating system, running on a *Lenovo Y500* laptop, equipped with *Intel i5 3230* CPU and *Nvidia GT750m* graphics card. Software used for performing the experiment was *hashcat* and *oclHashcat*.

Following results present mean values of all twelve iterations both on *hashcat* and *oclHashcat*. These results may and will vary according to different CPU and GPU configurations, due to the fact that the experiment was performed on previous generation hardware laptop that was considered to be average in terms of consumer usage. The metric "*Number of hashes per second*" represents the generation and comparison of hashes to the hash we are trying to collide with.

Table 1: Comparison of algorithms and their performance on different hardware

Algorithm	CPU/GPU	Number of hashes per second (lower is better)	Estimated time
MD5	CPU	37 million	250-300 days
Bcrypt	CPU	75	Over 10 years
SHA-512	CPU	690	Over 10 years
MD5	GPU	847 million	90 days
Bcrypt	GPU	68	Could not estimate
SHA-512	GPU	23.315 million	9 years 1 month

We can see from the above table that, in general, MD5 performed the worst in both CPU and GPU tests, where the GPU brute force attack provided more than twenty times better performance. This confirms that MD5, as a legacy algorithm, should be avoided at all costs.

One more interesting thing is the performance of the BCrypt algorithm experiment which was ten percent worse in number of hashes when performed on the GPU. Main reason for this anomaly is hidden in the fact that BCrypt requires a lot of memory accesses, which must be pipelined through the CPU when the brute force attack is being performed on the GPU, thus increasing the number of intermediate steps in generating the hash that is being used for comparison.

SHA-512 gives us drastic improvements when it is being attacked using the GPU, which, in turn, opens questions of its ability to provide a secure mechanism of hashing in modern business.

6. CONCLUSION

Even though the experiment performed is highly reliant on underlying hardware, we can safely conclude several things. One of them is that BCrypt presents significant advantages over SHA-512 and MD5 hashing algorithms. According to that, BCrypt should be used in place of SHA-512 and MD5 algorithms, where it is possible. SHA-512 can potentially provide better performance than BCrypt, but this statement requires more data to be either proved or disproved.

Next, we can safely conclude that eight character passwords which contain alphanumeric characters are a safe bet against brute force attacks, and in some way, adequate protection against dictionary attacks (due to the ability that dictionaries do not contain numbers paired with words, while implementing checks for numbers transforms the dictionary attack into a brute force attack). Additional improvements to the safety of algorithms can be added by implementing password salts, adding an additional layer of security to the hash by transforming it according to random data which is used later, in a reverse process, to reconstruct the hash.

It would be interested to note the performance of these algorithms on machines with much more performant hardware, including CPU and GPU clusters augmented by high frequency RAM. Also, extending the experiment to cover the winner of PHC (Password Hashing Competition) - Argon2 ("Password Hashing Competition", 2016) and to include other PHC finalists, due to their novel design and possible improvements over BCrypt.

REFERENCES

Andreeva, E., Mennink, B., Preneel, B. (2015). Open problems in hash function security. Designs, *Codes and Cryptography, 77(2), 611-631*, http://dx.doi.org/10.1007/s10623-015-0096-0

Dobbertin, H. (1996). The status of MD5 after a recent attack. *CryptoBytes,2(2).*

Khovratovich, D., Rechberger, C., & Savelieva, A. (2012, March). Bicliques for preimages: attacks on Skein-512 and the SHA-2 family. *In Fast Software Encryption, 244-263*. Springer Berlin Heidelberg.

KoreLogic Security. Crack me if you can, offical web page. *Retrieved from http://contest.korelogic.com/. Last visited 04/15/2016*

Maurer, U., Renner, R., & Holenstein, C. (2004). Indifferentiability, impossibility results on reductions, and applications to the random oracle methodology. *In Theory of cryptography, 21-39*. Springer Berlin Heidelberg.

Merkle R.C (1979). Secrecy, Authentication and Public Key Systems. *Ph.D. thesis, UMI Research Press*, Italy

Milenković, I., Šošević, U., & Simić, D. (2012). Architectures of comprehensive identity and access management. *Presented at Electronic International Interdisciplinary Conference, Proceedings of the EIIC,*

ISSN:1338-7871, ISBN 978-80-554-0551-3.

oclHashcat. Official project wiki. *Retrieved from https://hashcat.net/wiki/doku.php?id=oclhashcat, Last visited 04/15/2016*

Password Hashing Competition. (n.d.). *Retrieved from https://password-hashing.net/, Last visited 04/15/2016*

Provos, N., & Mazieres, D. (1999, June). A Future-Adaptable Password Scheme. In *USENIX Annual Technical Conference, FREENIX Track, 81-91.*

Silent Signal Techblog. (2015). Poisonous MD5 - Wolves Among the Sheep. *Retrieved from https://blog.silentsignal.eu/2015/06/10/poisonous-md5-wolves-among-the-sheep/*

Stevens, M., Karpman, P., Peyrin, T. (2015). Freestart collision for full SHA-1. *Retrieved from https://eprint.iacr.org/2015/967.pdf, Last visited 04/15/2016*

Rivest, R.L. (1991). The MD4 message digest algorithm, *Advances in Cryptology, Crypto'90, Springer-Verlag, 303-311.*

Stevens, M., Sotirov, A., Appelbaum, J., Lenstra, A., Molnar, D., Osvik, D. A., & De Weger, B. (2009). Short chosen-prefix collisions for MD5 and the creation of a rogue CA certificate. *In Advances in Cryptology-CRYPTO 2009 (pp. 55-69). Springer Berlin Heidelberg.*

Xie, T., & Feng, D. (2010). Construct MD5 Collisions Using Just A Single Block Of Message. *IACR Cryptology ePrint Archive, 2010, 643.*

Zivadinovic, M., Milenkovic, I., Simic, D., Seraphim: Linux kernel module for resource management and command execution. *Presented at Symorg 2014, Zlatibor, Serbia*

GIS IN BUSINESS MANAGEMENT

Mirjana Kranjac*[1], Uroš Sikimić[2], Srđan Tomić[3]
[1]University of Novi Sad, Faculty of technical sciences, Novi Sad,
[2] Singapore management university, Institute of Innovation and Entrepreneurship, Singapore
[3]University Nikola Tesla, Faculty for engineering management, Belgrade, Serbia
*Corresponding author, e-mail:mirjana.kranjac@uns.ac.rs

Abstract: *Nowadays, fast and effective decisions are the main request for the management staff in order to achieve company's sustainable development. Geographic information systems (GIS) are suitable ICT tool for management. GIS offers possibility to visualize spatial data and to make decisions faster. The authors are dealing with the problem how to improve internal communication within company. They are proposing application of GIS within company's communication what will bring benefit to the management teams in sense of more effective governing of their companies within the turbulent, changeable time. Their research, elaborated within a production company, proved that GIS contributes to better understanding between teams within company and to more effective decision making process when used for internal communication.*

Keywords*: GIS, business management, meter spatial information system, spatial data, visualization*

1. INTRODUCTION

Geographic information systems are a group of software useful to solve problems within many sectors of human activities. They are used in all areas which are dealing with spatial, georeferenced data. First implementation of GIS was by geographers and surveyors. They were designing different sorts of maps.
The scientists are conducting researches of various topics with GIS (Goodchild, 2010). They are presenting data into the maps, placed to their locations according to their coordinates, and separated into the more layers for doing investigations. Business subjects are implementing GIS with the goal to increase their profit. With GIS they do the following (Cheng, Li & Yu, 2007):

- Market research by:
- ✓ looking for the optimum locations of the headquarters, offices, distribution centers, selling points,
- ✓ analyzing trading possibilities, finding right empty niches for their products and services, (Moon, Lee, Ryu & Oh, 2014) and

- Marketing of products and services by:
- ✓ Presenting spatial distribution of consumers, distribution of customer's groups by their age, frequency of cooperation with the company, type of purchased products/services, results of surveys on customers' satisfaction etc. (Li, Kong, Pang, Shi, &. Yu, 2003), (Heywood, Cornelius & Carver, 2006).

Public utilities visualize utility infrastructure, maintenance centers, and malefactions locations, do project designs, prepare maps for the maintaining staff and doing new investments (Esri report, 2008).

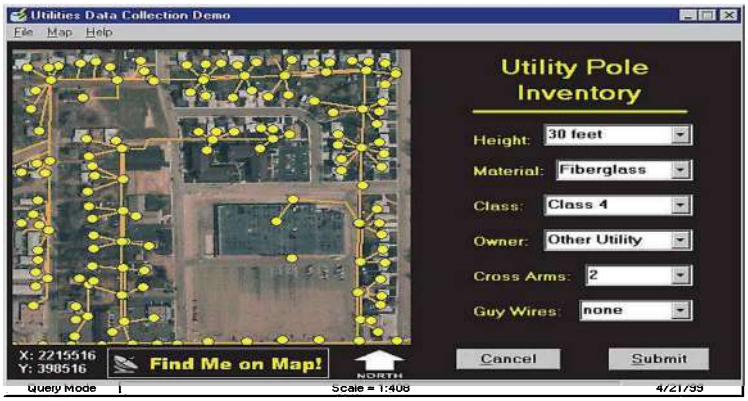


Figure 1: GIS in utility company. Source: http://www.esri.com/what-is-gis/who-uses-gis#utilities_panel

Prerequisite to utilize GIS software is to have data with geographic coordinates what enables their location on the maps. GIS maps consist of layers (Perry, Hakimpour, Sheth, 2006) which can be seen at the same time such enabling cross cutting of various data and watching them at the same time. Much less companies use GIS for solving management problems of companies and for decision making process. In some USA companies there are departments specialized in using GIS:

- for the problems solving (Esri in industry, 2015).

Utilization of GIS in such activities demands logical analyzing of problems and their decomposition into the spatial segments which are layers in GIS application. This process requests good experts knowing problems and their logical flows, as well as good experts of GIS presentation and if needed, experts for WEB surroundings. GIS enables viewing of decomposed layers and their overlapping which gives good platform to follow data influences, observe some significant inter-effects and to decide about problems' solutions (Kumar, 2013). Even, when problems are solved, new data are put into the layers and new effects can be again visualized and analyzed. This enables timely reactions and following the data changes through the time (Fu & Sun, 2010), (Kranjac, Sikimić, Dupljanin & Tomić, 2015).

The sector which is not covered by the use of GIS is business process management (BPM). Namely, BPM is a management discipline which integrates strategy and goals of a company with expectations and needs of customers in the way that "end to end" process is in focus. BPM includes policies, goals, culture, structure, IT to analyze, design, implement, permanently improves and compose good governing within "end to end" process in a company (Benedickt, Bilodeau, Vitkus & Powell, 2013). GIS is underestimated as ICT tool for visualization of existing business processes with their bottlenecks and milestones. GIS could enhance decision making process to company's management. GIS could be effectively involved as an ICT tool in:

- Meetings which should bring quick decisions
- Clear presentation of different business scenarios to the management
- Convincing the management into proposed solution
- Presentation to employees the situation
- Inform employees to know different scenarios of future development
- Proving what were good or bad solutions from the past (Burger, 2006).

These all should be done by GIS visualization much quicker than with other tools, because "an image is much more worth than thousand words".

The authors of the paper tackle the problem how to improve communication within actors of production process: management team and workers, by using geographic information systems. They are analyzing problem of workers' productivity by introducing spatial factors. Namely, spatial factors explain reasons of different productivity at the same type of machines within production plant. Reasons for differences can be discovered only when internal communication between management and workers runs smoothly. Spatial visualization created with GIS facilitates this good understanding (Kranjac, Sikimić, Vučinić &Trubint, 2015).

The authors want to prove that involvement of GIS applications into the dialogue between management and workers will bring better short-term outputs and long-term results of the companies and to prove the hypothesis that GIS can improve effects of the dialogues inside the company what brings total improvement of decision making process and better integral indicators of company's success.

2. LITERATURE OVERVIEW

Gaining competitive advantage is the main goal of the companies' management which will make company sustainable at the regional, national or international market or all of them. Growing number of corporations are looking for the ICT solutions which will enhance their functioning. The very important segment within companies is the way of communication between various groups: board members, management staff, employees in different departments, workers and the external world. External world are as the most important: costumers of products and services, distribution centers, dealers, financial institutions, logistic support points, marketing companies etc. Fast and clear communication without artifacts', confusions and conflicts makes company faster growth, easy functioning and spreading. Visualized data bring much more information into the communication process than any other type of data. This is even more important when one takes into account that companies' owners are not always experts from the area of organization activities and they need simple and exact explanations enough well presented to bring easy and right decisions.

GIS and data visualization as analytical and decision support packages are recognized as powerful tool in

corporations. When dealing with big data, what is usually the case, GIS contributes to the intuitive comprehension of big data. This enables bringing fast solutions. The experts who are preparing GIS presentations must identify crucial variables. Than GIS will help them in analyzing relationships between the significant factors. In some cases, when applications are user friendly and/or in put in web platform they enable end users investigations which they do by themselves (http://fargeo.com/blog/gis-and-big-data-visualization/). Sometimes, maps or layers made with GIS are too complicated, in too many colors what could make them incomprehensible for users who they are prepared for. This is a risk which new technology brings, that with desire to use it with more power, it could be turned into its opposite. Risks of GIS could appear during customization and integration. Sometimes layers could be visually overwhelmed what brings unclear vision to the users and even can confuse them. Deep analyzing process, careful approach and serious studding are inevitable when using GIS (Gioules, Hannmann Jodi-Lee& Evan Sullivan, 2010).
Some authors present a comprehensive approach for computing of navigation for an indoor space. They focus on a single floor, but the work is easily extensible to multi-level spaces. This is a small example of using GIS to solve some organizational problems. They use a formal model and combine map with geometric and semantic information. The program takes as input the building plans with geometric structure of the floors and semantics of the building and connects with GIS mapping (Yang and Worboys, 2015).
In some cases GIS is a mean for the interchange of information between departments what is shown in some papers. Such use is fostering horizontal connections between departments and it enables better understanding of "the whole picture of the comapany". Use of GIS when analayzing efficiency of a company, a postal enterprise, is described in paper of Kranjac, Sikimić & Vujaković, 2015. The authors explain some maps which reflects efficiency and productivity data within the postal department in JP PTT „Srbija".

3. CASE STUDY: GIS WITHIN COMMUNICATION PROCESS IN ENTREPRISES

Authors of the paper wanted to find GIS solutions which would enhance dialogue between:

- management staff and workers.

The goal was to improve companies' results. For this reason they explored a production company with 10 employees, 7 working on machines, in the production plant. They researched two problems:

1. problem of machines' productivity and
2. problem of employees' productivity.

They did following calculations:

Machine productivity = number of produced parts per machine per hour
Employee productivity = number of produced parts per employee per hour

These calculations are usual measures of production effectiveness. To better analyze and understand the situation, authors included the geographic position, actually locations of machines, as an important factor to analyze input elements of production's productivity. Data are presented in GIS layers what enables better understanding of problems.
The maps made in GIS can show different aspects of the quality and work's results and assist management to present this to workers on a visualized way, more understandable to workers.
The following example explains GIS maps which were used for the discussion between management team and workers about productivity of production process and reasons of the differences between workers/machines' results.
First example shows visualized data about productivity. The second example implements new factors which explain differences of production productivity elements, which workers pointed out and which are coming from their experience and explanations. These new spatial factors are described as bottlenecks in the process of taking input material for the machines. By simple actions they could be reduced or completely canceled and thus total productivity could be increased.

Example 1.

Figure 2. presents placement of machines in one manufacturing plant of the company. There are 7 machines in it and they are marked with labels: A, B, C, D, E, F and G.

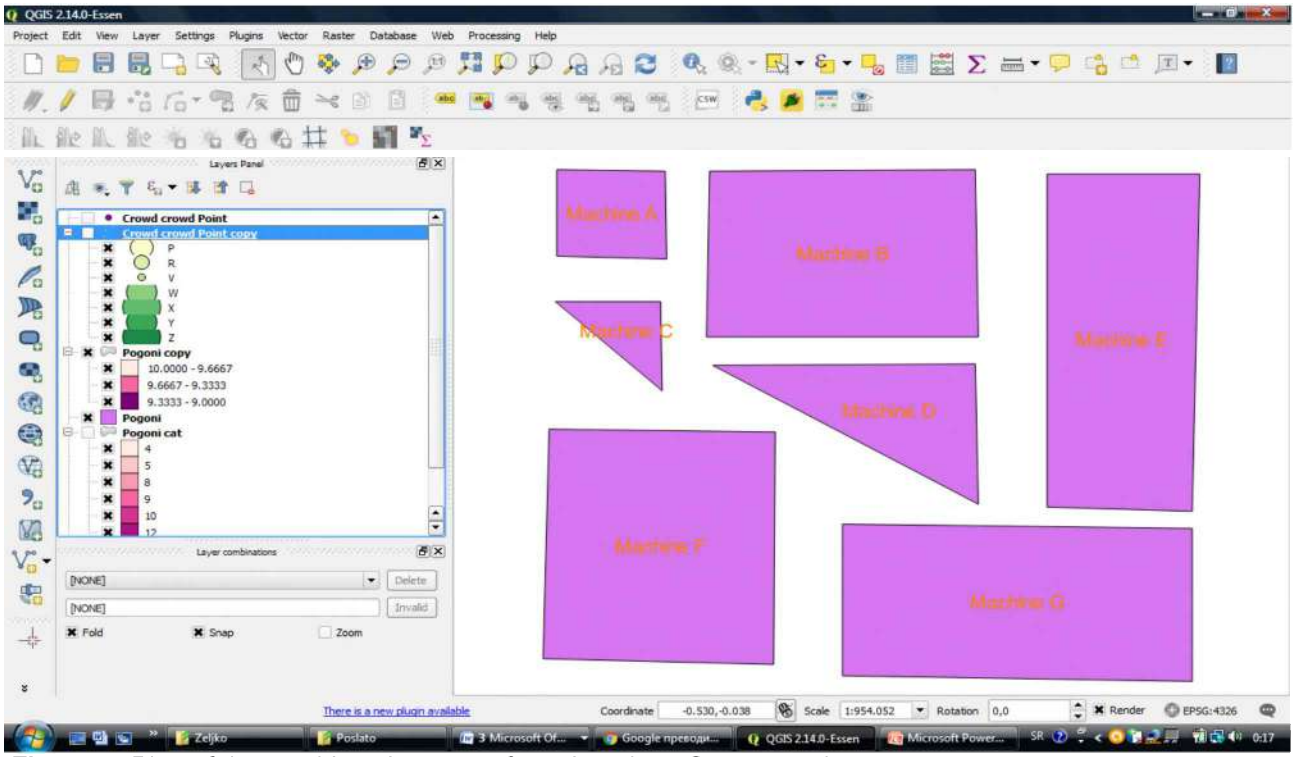


Figure 2: Plan of the machines in a manufacturing plant. Source: authors

In next Figure 3. are shown machines in different colors in such way that colors are sorted to the value of machine's productivity per one hour. The darker color, the more productive of the machine. The most productive is machine marked with A, with 12 produced pieces per hour and the least productive machine is labeled G, with 4 produced pieces per hour.

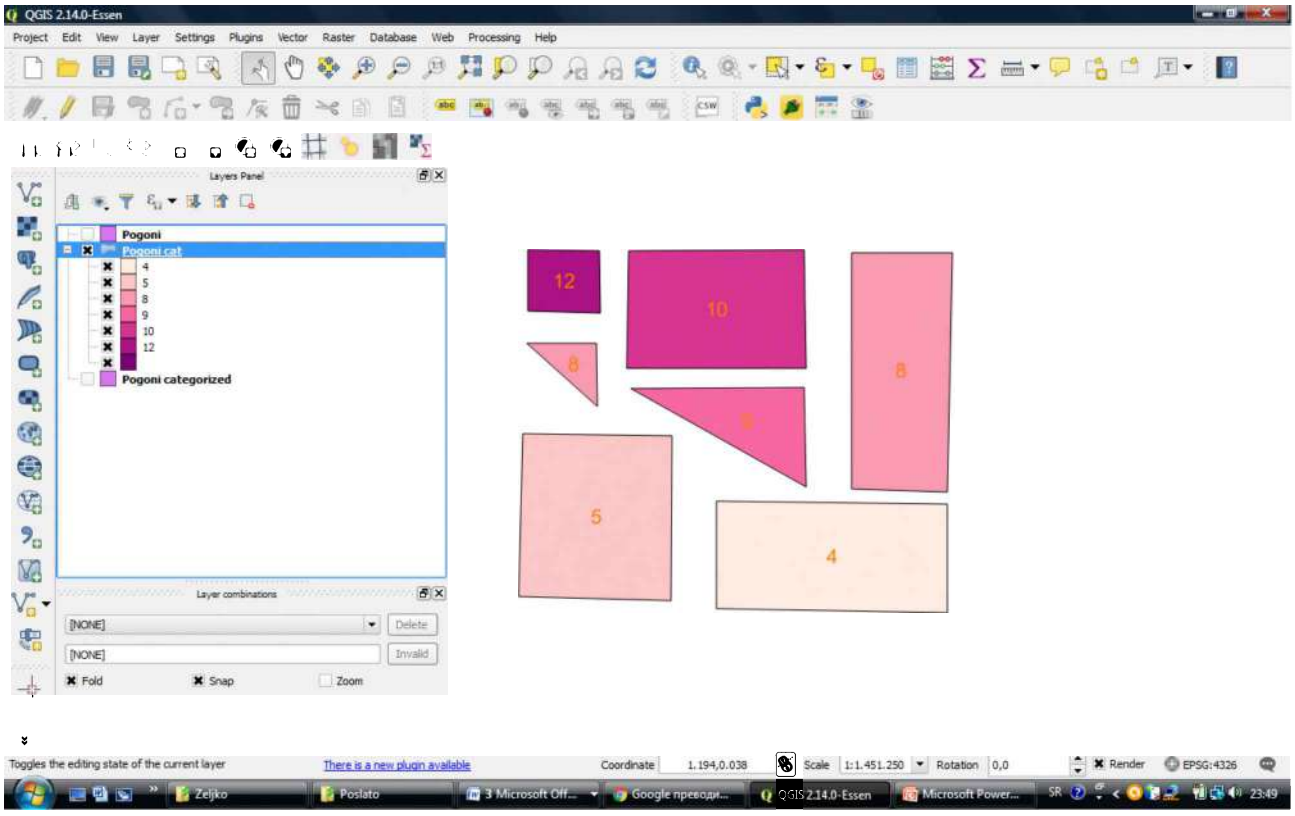


Figure 3: Colors ranged according to the machine productivity. Source: authors

Example 2.
This example shows the new factor which influences workers during their work on machines. Use of GIS map, in this case, is a tool for workers to explain their problem to the management. The circle's size presents

the bottlenecks for the movement of workers when they are taking input material for production. The spatial plan of machines or location of input materials, should be changed. GIS map is the best way to make the problem understandable to the management, by visualizing it. Namely, at Figure 4, the size of the circles and their color present the intensity of the problem which the workers have when they are moving through the production plant. If the color is darker and the circle's size is bigger, the problem is more expressive.

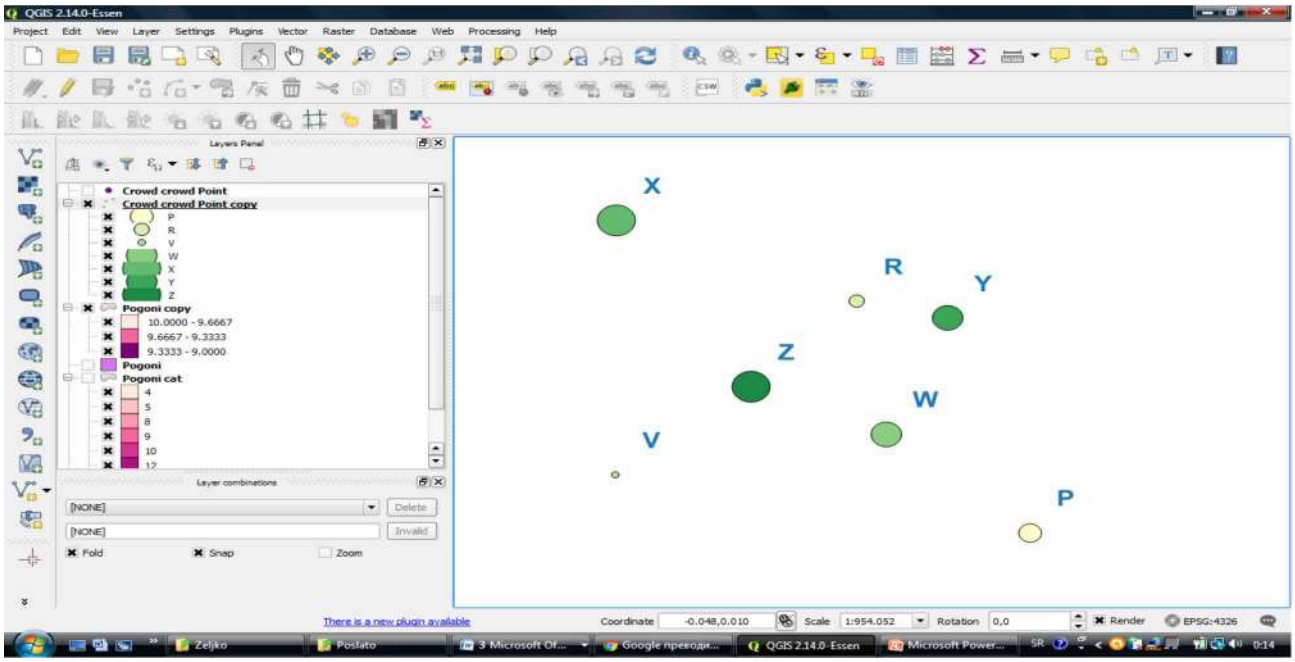


Figure 4: Bottlenecks in the manufacturing plant of the researched company, visualized by size and color. Source: authors

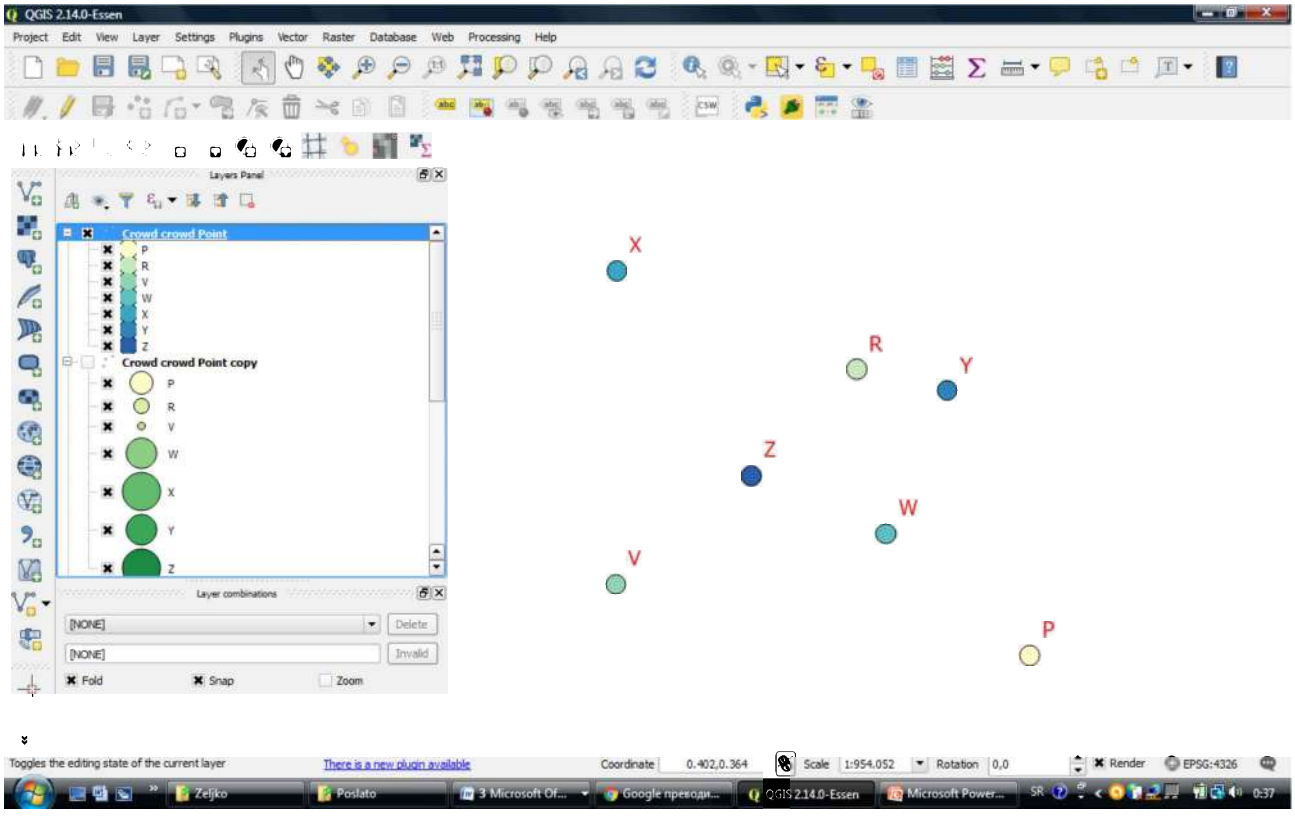


Figure 5: Bottlenecks in the drive of the researched company visualized by color. Source: authors

Figure 5 is less expressive; it presents the information only by color, and not by size of the circle.
Both examples show contribution of GIS in the process of communication within groups which are participants in the processes within companies.

4. TESTING RESULTS OF THE CASE STUDY

The maps described in examples 1 and 2 are results of authors' research. Maps are results of discussion between authors' team and two groups from the explored company: workers and staff members. Problems presented in examples were problems which these two groups from the company wanted to clarified and solve.

GIS maps were elaborated according to their demands. After the GIS maps were done, authors wanted to measure the effects of their use to the groups and made a survey. The results of survey made for workers are presented in Figure 6. The question was: "How do you assess the contribution of GIS maps to better communication between workers and management?"

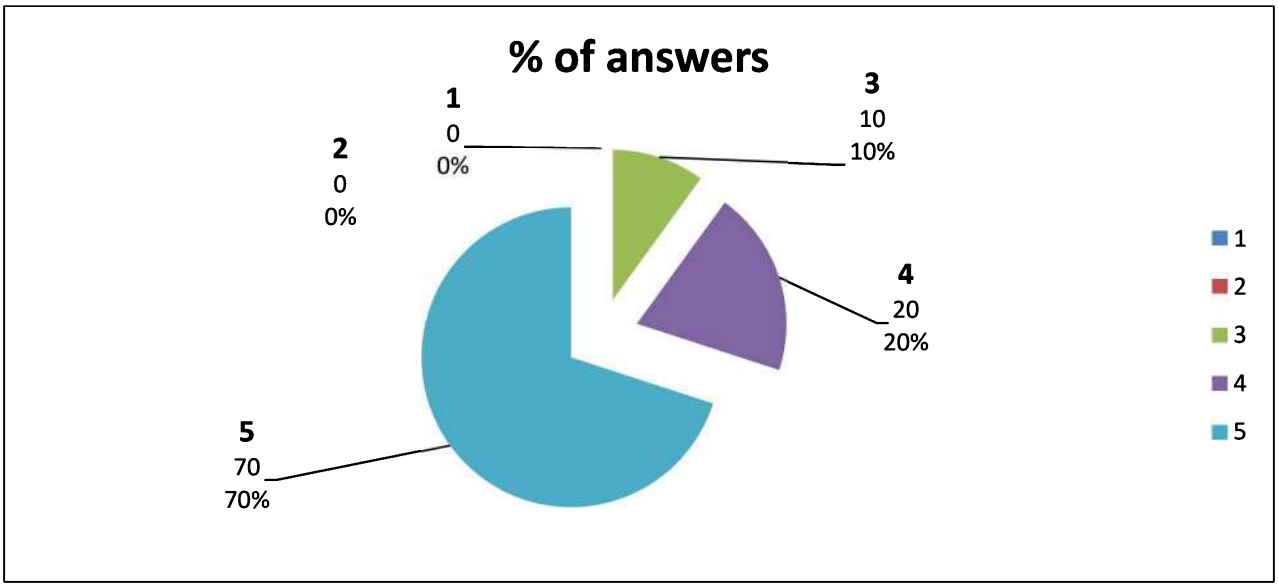


Figure 6: Assesment of workers (1 is the worse, 5 is the best). Source: authors

The results of survey made for management staff are shown in Figure 7.

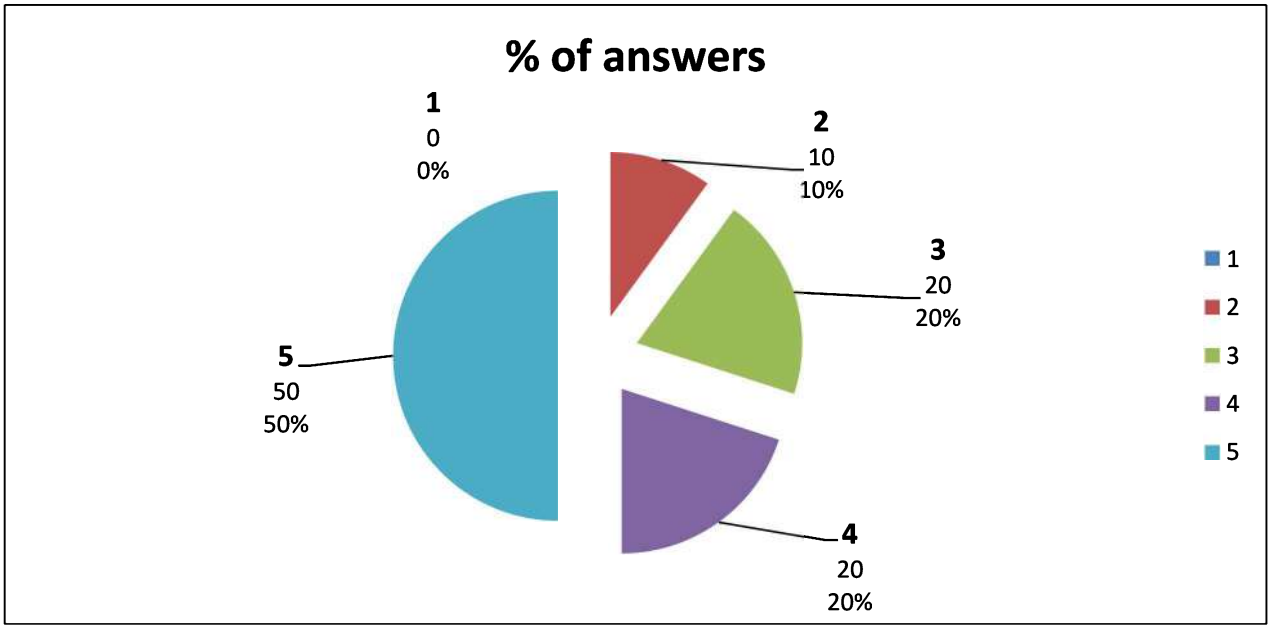


Figure 7: Assesment of management staff (1 is the worse, 5 is the best). Source: authors

The results show that management staff was less satisfied by the use of GIS maps, than workers. They had more doubt and have to be more trained about GIS and convinced of its usefulness.

5. CONCLUSION

The paper presents preparation for the meetings between management and workers enhanced by the use of GIS. GIS shortens their duration and improves the dialogue atmosphere. Authors' case study and survey prove the proposed hypothesis that GIS can improve effects of the dialogue inside the company and improve communication effects and business results.

The authors' scientific contribution is implementation of spatial information into the productivity problems that were subject of the internal communication. Spatial information is the digital connection between location, people and activities.

They presented use of an ICT tool, GIS software, in business management. Besides geographic information system which use is for larger spaces, authors introduce a sub GIS dimensions (defined by the accuracy of GPS), which are used in smaller spaces, like: production plants, logistic centers, laboratories,... This leads to the nano spatial management system which is dealing with nano dimensions.

Research should be continued and diversified to other factors of business management process with spatial components which were not analyzed before and which can bring improvement of business results.

REFERENCES

Benedickt, T., Bilodeau, N., Vitkus, P., Powell, E. (2013). BPM CBOK Version 3.0: Guide to the Business Process Management Common Body Of Knowledge, ABPMB, ISBN-13: 978-1490516592

Burger, A. (2006). GIS, Part 3: Making the Most of Your Enterprise Data", *E commerce Times*. http://www.ecommercetimes.com/story/53544.html

Cheng, E., Li, H. & .Yu, L. (2007). A GIS approach to shopping mall location selection, Building and Environment, 42 (2), 884-892.

ESRI Report, 2008, Retrieved from http://www.esri.com/news/arcnews/summer08articles/usps-fights-crime-with.html

Esri in industry (2015). Available: http://www.esri.in/industries/government/egovernance

Fu, P. & Sun, J. (2010). *Web GIS: Principles and applications*, ISBN:158948245X 9781589482456, Esri Press, New York, 25-28.

Garnett, R, Kanaroglou, P. (2016) *Transactions in GIS*, Volume 20, Issue 1, 1–159, John Wiley & Sons Ltd, New York

Gioules , M., Hannmann Jodi-Lee, L. & Evan Sullivan, S. (2010) Sustainable transportation mapping, Worcester Polytechnic Institute

Goodchild., M. (2010). Twenty years of progress: GIS science in 2010, *Journal of Spatial Information Science*, 12-13.

Heywood, I., Cornelius, S. & Carver, S. (2006). *An Introduction to Geographical Information Systems*, (3rd ed.), Essex, England: Prentice Hall, 230-232, 2006.

Kranjac, M., Sikimić, U., Dupljanin,Dj. & Tomić, S. (2015). Use of Geographic information systems in analysis of telecommunication market, *Proceeding ICIST 2015*, Kopaonik, 303-308.

Kranjac, M., Sikimić, U and M. Vujaković, Model for calculation of post service efficiency by using GIS", *Proceeding Mipro 2015*, Opatija, ISBN 978-953-233-083-0, 353-359.

Kranjac, M., Sikimić, U, Vučinić, M. & Trubint, N. (2015). The use of GIS in the model of implementation of the light train transport in Novi Sad, *Conference Towards a human city*, Novi Sad, FTN, ISBN 978-86-7892-541-2, 124-130.

Kumar, A. (2013). Participatory GIS for e-governance and local planning: A case study in different environments on its applicability, *Proceeding of Centre for Study of Regional Development*, New Delhi, India.

Li, H., Kong, C., Pang, Y, Shi, W. &. Yu, L. (2003). Internet-Based Geographical Information Systems System for E-Commerce Application in Construction Material Procurement, *Journal of Construction Engineering and Management,* Vol. 129, No. 6, 689-697.

using 3D GIS Information, *International Journal of Information Technology & Computer Science*, Volume 14 Issue No 1, 25-33.

Perry, M., Hakimpour, F. & Sheth, A. (2006). Analyzing theme, space and time: An ontology-based approach, *Proceeding: ACM International symposium on Geographic information systems* , 147–154.

Yang, L., Worboys, M. (2015). Generation of navigation graphs for indoor space, *International Journal of Geographical Information Science*, Volume 29, Issue 10, 1737-1756, Taylor&Francis, New York

Retrieved from http://www.esri.com/what-is-gis/who-uses-gis#utilities_panel

http://fargeo.com/blog/gis-and-big-data-visualization/ Retrieved: 2nd. March 2016

PROSPECTS AND TRENDS IN THE DEVELOPMENT OF TELEMEDICINE

Marina Jovanovic Milenkovic[1]*, Dejan Milenkovic[2], Slobodan Ristic[1]
[1]Faculty of Organizational Sciences, University of Belgrade
[2] Serbian Armed Forces General Staff
*Corresponding author, e-mail: marinaj@fon.bg.ac.rs

Abstract: *The telemedicine has emerged middle of the last century but its implementation has just begun with introduction of the information - communication technologies. Information-communication technologies led to the fact that telemedicine is applied effectively, efficiently and with better quality. In European countries, telemedicine has developed with a different tempo. The paper describes the development of telemedicine trends during 2016, such as: Expanding Reimbursement, International connectivity and Arrangements, Continued Momentum at the State Level, The increase in telemedicine services in hospitals, Using Technology to improve care and reduce costs. The paper provides an overview of the application of telemedicine services in Europe and in Serbia, also the prospects of further development.*

Keywords: *health system, information - communication technologies, telemedicine, trends in development, telecardiology*

1. INTRODUCTION

The health system is one of the most complex systems of any country. The goal of health care system is a healthy population. In order to achieve the objective, the health system has experienced many changes. These changes relate to the introduction of the informational and communication technologies (ICT). ICT have led to the development of telemedicine services (Jovanović Milenković, Jeremić, Martić, 2014). Telemedicine aims to provide advice and support, and to reduce the chances of illness or injury. This paper gives an overview of trends in the application of telemedicine during 2016.

2. TELEMEDICINE

The primary goal of any health care services for the population is security, health and longer living. Prevention often reduces the need for treatment. Telemedicine therefore seeks to provide advice and support, and to reduce the chances of illness or injury. Historically, technology has evolved over the centuries to give the population a better future. That is why greater interest is to improve medical and health technology and to provide more efficient and accessible services to as many people as possible.

Medical and health technology is being used by everyone: patients, doctors, health care workers, end-users, engineers, clinicians and hospitals, etc. Health services are no longer restricted to be provided in certain locations such as clinics and hospitals, but communication technologies are transferred to users who are on the move or at home. Caring for the community is to assist people with disabilities, taking care of children and the elderly, treating sick or injured, as well as support to vulnerable individuals.

Telemedicine is a combination of information and communication technology, multimedia and computer networks for the transfer of medical data. The word telemedicine is composed of the Greek words *tele* which means distance and the word *medicine*, which means the medicine at a distance.

Today in the world there are following definition of telemedicine:

- In the journal The Telemedicine Information Exchange (Brown, 1996) defines telemedicine as the use of electronic services for the transfer of medical data from one side to the other through the Internet, phones, computers, satellites or video conferences in order to provide health care services.
- Author Reid (1996) defines telemedicine as a use of complex technology for the exchange of information of health and health service delivery, where there are geographical, temporal, social or cultural constraints. Telemedicine involves the use of informational and communication technologies, and two-way interactive audio/video connection and a computer. This allows the provision of health services to distant patients. This facilitates the exchange of information between primary care physicians and specialists who are far from each other.

- Telemedicine is extending health services to remote and exchange medical information using the information-communication technologies. Its meaning is broad and includes activities such as prevention and disease diagnosis, treatment, medical education of users, research and evaluation in medicine. The application of telemedicine beyond the physical, temporal, social, and cultural barriers. It reduces the potential time and cost of transportation of the patient to the doctor, or the doctor to the patient. The emphasis in telemedicine is the transmission of information between doctors and health care users.

Among these variations of the definition, there are several things that are common. First, the definition of the term was created in the 1990s. Secondly, it has been providing different kinds of medical services from a distance using information and communication technologies. The most important aspect of telemedicine is quality, because the diagnostic and therapeutic quality improves. It also allows early detection of adverse effects of the applied therapy.

In recent years, with the introduction of internet technologies, telemedicine is more developed. In the health system, telemedicine has experienced growth in all branches of medicine. On the global market, every country has done a lot on infrastructure development (Kamsu-Foguem, Tiako, Fotso, Foguem, 2015).

3. TRENDS IN THE DEVELOPMENT OF TELEMEDICINE

3.1. Development factors of telemedicine

Services of telemedicine are experiencing big growth in health systems both in developed countries than in developing countries (Ekeland, Bowes, Flottorp, 2012). But it has not being developed in all countries equally. Diversity emerged depending on the level of development of the country (Boubacar Traore, Kamsu-Foguem, Tangara, 2016). In developed countries, the country is faced with the following problems:
- An increase in the elderly population;
- Increased costs of technologies that provide medical services
- Patient expectations are higher
- Economic and social changes.

Their problems have led to disparities in the provision of health services. State governments have tried to solve this problem in two ways: through tax increases and increased costs of providing health services. Given the complexity and sensitivity of the problem, the only solution that arises is through a variety of telemedicine services, reduction of costs.

The key factors that have helped the development of telemedicine (Norris, 2001):
- Expanded access to health services;
- Health care for the population who is constantly traveling;
- Military applications;
- Tele-home care;
- Reduction of costs;
- Market Development;
- Health Policy and Strategy

Expanded access to health services
Expanded access to health services includes access to health services of individuals who live at a great distance from large urban centers. They are motivated to use telemedicine services. Some parts of Australia and America are examples where residents do not have proper medical specialists in the environment of life and apply these services. Also, these services are intended for the handicapped, the elderly and people who have mental difficulties.

Health care for the population who is constantly traveling
Telemedicine is an important factor in the health insurance department. Some examples can be sailors, who spend their life time at sea. In these circumstances, radio connections play a big role to provide medical advice for many years. Transfer of ECG, X-ray images and video conferencing can greatly help a patient who at that time seeks medical assistance. Similar problems may happen to astronauts or passengers while being on flights.

Military applications
Military insured person who is in the inaccessible terrain may seek medical care supported by applications. Video conferencing is the best way to communicate with the military insured.

The US military applied system *Primetime I11*, which provides an opportunity for health care, regardless of geographic location. This approach has been used by the troops who took part in the NATO operation in Bosnia and Herzegovina.

Tele-Home Care
Tele-Home Care is designed to provide medical care for the elderly. In 1998, there were 380 million people who have had more than 65 years. That number is growing all over. Two thirds of the population older than 65 years are living in developed countries.

Increasing the number of older population also leads to changes in diseases. The application of tele home care, leads to every patient and care of his health, but at the same time reducing the costs of hospitalization, which is very expensive and the arrival of a doctor on a home visit. Home visits are replaced with tele-visit.

Costs reduction
The application of telemedicine put an influence on reducing some of the costs in the health system. The costs include costs of arrival and departure physician home visits, reduce medical and economic costs that can occur when a specialist works in the rural areas.

Market development
A few years ago the world has been using only analog signals during data transfer. Today, digital signals are applied in telemedicine.

Health policy and strategy
Each country should adopt a health policy and future strategy of applying telemedicine in its country. Adequate strategy makes it possible to do the infrastructure required for the provision of such services.

3.2. Trends in telemedicine during 2016

The global telemedicine market will become larger at a compound annual growth rate of 14.3 percent through 2020. It is anticipated to reach $ 36.2 billion. During 2014 there was a $ 14.3 billion (Lacktman, 2015). According to some authors, these five trends will drive telemedicine's continued growth and transformation of health care delivery in 2016:

- Expanding Reimbursement
- International connectivity and Arrangements
- Continued Momentum at the State Level
- The increase in telemedical services in hospitals
- Using Technology to improve care and cut costs

1. Expanding Reimbursement
Private and state institutions continue to develop telemedicine services. This will lead to better service delivery and will lower the cost. The main obstacle in providing health services were cost. But changes in the law will lead to a reduction of these costs.

2. International connectivity and Arrangements
In 2016, hospitals and health services will have to establish ties overseas medical institutions. In this way, knowledge of health care expands abroad. This cross-border partnership will allow access to a larger number of patients, to generate additional income. According to the American Telemedicine Association, more than 200 academic medical centers in the US already offer video-based consulting in other parts of the world. While many of these are pilot programs, 2016 will come to the commercialization of the majority of those treaties. The increase of a purchase power happened in the middle class population in countries such as China, and also the opportunities for growth is in Western medical centers.

3. Continued Momentum at the State Level
State authorities are working on the implementation of telemedicine services. Many states have passed laws that provide health care services via telemedicine, during 2015.

4. The increase in telemedical services in hospitals
A recent study found that more than 35 percent of employers with onsite health facilities offer telemedicine services, and another 12 percent plans to add these services in the next two years. Other studies suggest that nearly 70 percent of employers will offer telemedicine services as an employee benefit by 2017 (Lacktman, 2015).
Additionally, consumers are increasingly willing to visit retail medical clinics and pay out-of-pocket for the convenience and multiple benefits of telemedicine services when telemedicine is not covered by their insurance plans.

5. Using Technology to improve care and cut costs
Using technology and Internet, 2016 will be the year of telemedicine. In that way, the costs will be so the patients would take the best health services.

4. PROSPECTS OF TELEMEDICINE SERVICES

4.1. Prospects of telemedicine services in Europe

Telemedicine applications are constantly growing. The following figure 1, according to research, is done for Europe (Somsainathan, 2011). It was noted that telemedicine in Europe is mostly applied in the UK. The second place is Germany, and then Scandinavian countries. Teleradiology is used 66% in the UK and Scandinavian countries, while services in Telecardiology are highest in the UK with 6%.

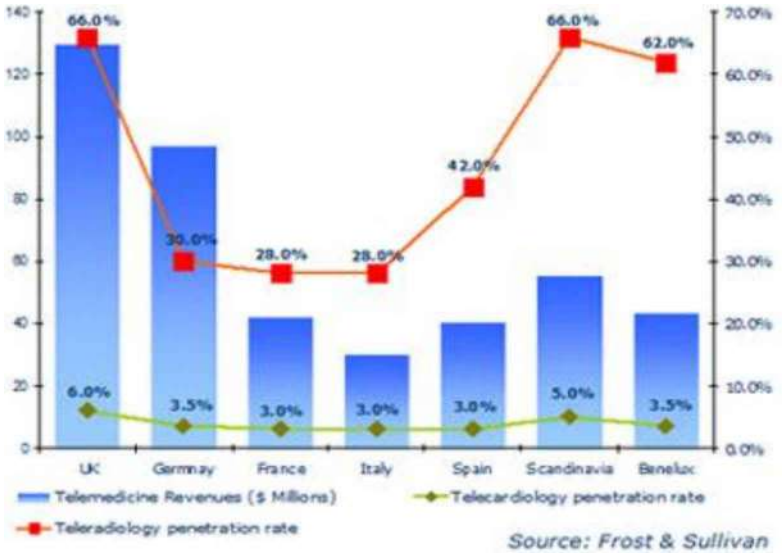


Figure 1. Application of telemedicine in European countries (Somsainathan, 2011)

According to a survey done in 2013, it is considered that the use of telemedicine and its services is increasing every year (UCLA, 2013). The study referred to the consideration of the parameters that affect the application of telemedicine. The period of time is perceived from 2005 to 2013. On that basis, forecasting is done of the application in telemedicine is to be in year 2030. This is seen in the graph Figure 2, which shows that the use of telemedicine increases, ie. that an increasing number of doctors applying telemedicine and its services and providing health care services over the years.

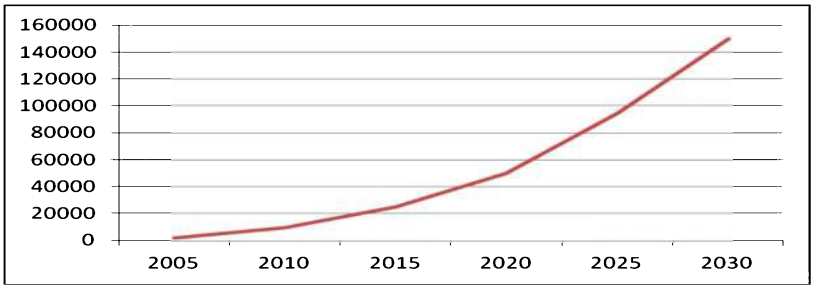


Figure 2. The application of telemedicine in the future (adapted from UCLA, 2013)

4.2. Prospects of telemedicine services in Serbia

In Serbia, telemedicine was developed in the 1990s. The first project was launched in the context of the Telemedicine Center in Belgrade, the Military Medical Academy (MMA), the Institute of Pathology and Forensic Medicine. When this project began, digitized libraries of classic glass started to slide. Telepathological established a permanent link between the Military Hospital and the Institute of Pathology, Faculty of Medicine and the Military Medical Academy in Belgrade, 1997. (Milosavljević, Spasic, et al 1997). The project was launched in the application of telemedicine services that related to sampling during surgery in Nis, and sent to Belgrade to determine the diagnosis. Although there was a modest technology, the telemedicine connection is proved safe. Since then it has functioned permanent connection to Nis, where the MMA has made several experimental relationship with other medical centers in Podgorica, Sremska Kamenica, KBC Bežanijska Kosa, where it carried out the transfer of radiological images, in addition to digitized microscopic images.

In recent years, Serbia was working on the introduction of electronic health records and electronic cards (Jovanović Milenković, Milenkovic, Jeremić, 2014). The hospitals are mainly used teleconsultation with doctors who are on other geographical localities. In most cases applied in cardiology.

In Emergency service vehicles are installed equipment that allows data transfer to the hospital. In Belgrade, Emergency service vehicles are equipped with modern apparatus for the transmission of ECG signals. These devices make it possible to record the ECG transmitted directly to the central Emergency Department regardless of whether the record was made in the apartment of a patient, in a public place or in the ambulance. The record is transmitted through GSM (Global System for Mobile Communications) on the server, where it is available for review and analysis by more doctors. In this way, by teleconsultation, doctors may indicate the doctor who is next to the patient so which is the best way to administer first aid to the patient. This ensures a higher quality of services and more accurate diagnosis. In addition, a team of doctors who are in the hospital can quickly and adequately provide further medical assistance (Reljin, Gavrovska, 2013).

In April 2016, MMA organized online course entitled "ENT surgery live - online". Speakers talked about education via the Internet as the most modern method of distant learning. Thanks to ICT technology, consumers had the opportunity to watch a live webcast of four operations in the field of otolaryngology, supported by the *Big Blue Button* software for distance learning, with a *Medapp Moodle* educational platform. The physicians performed in the operating room at the MMA. In addition to involvement in the educational platform of audio or video link, users had the possibility of direct communication with the operator. They were able to ask questions via the audio link or messages in real time, and the possibility of mutual communication and communication with the moderators of the course. The moderator has joined the course in Basel. Doctors for otolaryngology responded to the message. Clinic of ENT has organized such a course in which for the first time in the region otolaryngology surgery transmitted live via the Internet, certainly made a pioneering endeavor and set a new standard in the field of education (The Military Medical Academy, 2016).

Figure 3. ENT surgery live – online (The Military Medical Academy, 2016).

At the global level, it is necessary to support the development of adequate infrastructure for the development of telemedicine services.

4. CONCLUSION

The health sector has undergone various changes in recent years. These changes were related to the introduction of information and communication technologies. This was reflected in telemedicine. But telemedicine is characterized by various factors that makes it more efficient. These include: Expanded access to health services; Health care for the population who is constantly traveling; Military applications; Tele-home care; Reduction of costs; Market Development; Health Policy and Strategy.

Pursuant to these factors, the paper describes the trends that are crucial for the further development of telemedicine in the course of 2016. These are: Expanding Reimbursement, International connectivity and Arrangements, Continued Momentum at the State Level, The increase in telemedical services in hospitals, Using Technology to improve care and cut costs.

Analyzing trends can be observed on directions of development of telemedicine in Europe. The paper is an overview and future projections described providing telemedicine services in Europe. Telemedicine in Europe mostly applied in the UK. The second place is Germany, and then Scandinavian countries. Teleradiology is used 66% in the UK and Scandinavian countries, while telecardiology services are highest in the UK 6%. In Serbia, it is shown to be the intensive use of new technology in telemedicine. Devices are introduced into the ambulance, which will help in monitoring the health status of the patient remotely. In April 2016, the MMA did the first online operation in the field of otolaryngology. More specifically, doctors were able to follow four operations online in the field of otolaryngology, supported by the Big Blue Button software for distance learning, with a Medapp Moodle educational platform.

At the end, we can conclude that telemedicine is a sector that every day is more and more developed with the aim of better medical care of patients. Telemedicine influence to provide quality health services. The paper shows that hospitals in Serbia following the development and to provide of telemedicine services. This concept should be expanded to all hospitals in Serbia to the entire population had adequate health care. Constant development and growth in use of telemedicine in the future is inevitable.

REFERENCES

Boubacar Traore B., Kamsu-Foguem B. & Tangara F., (2016), Integrating MDA and SOA for improving telemedicine services, *Telematics and Informatics 33*, 733-741

Brown, N. (1996). Telemedicine Coming of Age. Telemedicine Information Exchange. Retrieved from http://tie.telemed.org/articles/article.asp?path=telemed101&article=tmcoming nb tie96.xml

Ekeland A.G., Bowes A. & Flottorp S., (2012). Methodologies for assessing telemedicine: a systematic review of reviews. *International Journal of Medical Informatics 81 (1),* 1–11.

Jovanović Milenković M., Jeremić V. & Martić M., (2014). Sustainable Development in the e-Health Sector of the European Union. *Journal of environmental protection and ecology. 15(1*), 248-256

Jovanović Milenković M., Milenković D. & Jeremić V., (2014). *Introduction and Implementation of Electronic Health Card.* In Maja Levi Jaksic, Sladjana Barjaktarovic, Milan Martic (Eds) Innovative Management and Firm Performance- An Interdisciplinary Approach and Cases. 444-464, ISBN 978-1-137-40220-2

Kamsu-Foguem B., Tiako F.P., Fotso P. L. & Foguem C. (2015), Modeling for effective collaboration in telemedicine, *Telematics and Informatics 32*, 776-786

Lacktman M. N., (2015), Five Telemedicine Trends Transforming Health Care in 2016, Retrieved from https://www.foley.com/five-telemedicine-trends-transforming-health-care-in-2016/

Milosavljević I., Spasić P., et al. (1997). Centar za telemikroskopsku dijagnostiku u Zavodu za patologiju i sudsku medicinu VMA. *Acta Medica Medianae XXXVI. 1*. 5-12

Norris A.C., (2001). Essentials of telemedicine and telecare. John Wiley & Sons. New York. ISBN 0-471-53151-0

Reid, J. (1996). A Telemedicine Primer: Understanding the Issues. Innovative Medical Communications. ISBN: 0965304507.

Reljin I. & Gavrovska A., (2013). Telemedicina. Akademska misao. Beograd. ISBN 978-86-7466-458-2

Somsainathan. C.K., (2011). Telemedicine: The Inevitable Component of Modern Healthcare, Medical devices, Frost & Sullivan. 4(2)

The Military Medical Academy, (2016), First ENT Surgery Live via the Internet Held at MMA, Retrieved from http://www.vma.mod.gov.rs/eng/

UCLA (2013). Pilot program study finds pediatric obesity patients like telehealth services. Los Angeles. University of California.

MODEL-DRIVEN APPROACH TO THE IMPLEMENTATION OF WEB SERVICE INTERFACES FOR 4GL SYSTEM

Slavimir Vesić*[1], Nenad Aničić[1], Slađan Babarogić[1]
[1]University of Belgrade, Faculty of Organizational Sciences
*Corresponding author, e-mail: vesic.slavimir@gmail.com

Abstract: *Interoperability becomes one of the most important demands for IT function in company. 4GL-based information systems are present a few decades in IT industry and because of their inflexibility they make big problems in the design, implementation and maintenance of software for modern business. Large number of these systems are faced with the inability to meet the demands of design in a way that they does not support business processes or the inability to use the latest technologies and solutions. Because of that they are actually legacy system. Solution that exposes 4GL procedures of legacy system as Web services is not effective in a situation where we have a large number of changes in the legacy system and high dependencies between procedures. So, if we design executable specification of the existing 4GL procedures and execute it as runtime model we can achieve interoperability. In first phase we specified transformation of Web service model to 4GL procedures model and as result we have annotated model. In second phase we designed algorithm that performs interpretation of annotated model and runs existing 4GL procedures in legacy system. To achieve this we used MDA approach and UML profiles. Proposed solution is explained in the example of execution of the distributed workflow between public utility companies in Belgrade.*

Keywords: *interoperability, MDA, 4GL, legacy system*

1. INTRODUCTION

Fourth generation of programming languages, briefly 4GL, was created in the period from 1970 to 1990 with initial idea to reduce time, efforts and resources which are invested in programming and learning conventional programming languages of third generation, briefly 3GL, as Pascal, Cobol and C. The need in the industry at that time was to reduce the dependence of professional programmers and to shift the focus on the user, which led to the idea that the development environment will be opened to the general population and programming will be more simplified. 4GLs are designed for specific problem domain, e.g. development of business software. In comparison to the generation of programming language before them, they are one level of abstraction away from the machine, which means that they are closer to the problem domain. Depending on the application, they can be classified into several categories: table-driven programming languages, report-generator programming languages, forms generators and data management 4GLs. 4GLs can be procedural languages or not or they can combine both concepts. Examples some of these programming languages are: Clipper, FoxPro, PowerBuilder, SQL, Informix 4GL, Ingres 4GL, Progress 4GL, Oracle Reports, ABAP, Clarion etc.

Legacy systems are old information systems which are still in use in the organization because they support fundamental business processes and the organization cannot or does not want to replace them or to redesign them. Legacy systems developed in the past, usually used older or obsolete technology. These systems are consist not only of hardware and software but also they include legacy procedures and processes – old way of doing things that are difficult to change because they rely on legacy software (Somerville, 2010). On one hand, enterprises see legacy systems as barriers to implementing new business processes because they are hard to adapt to new business requirements. On the other hand, they contain priceless knowledge about business and business operations. Because of these facts, enterprises are in dilemma what to do with them. Van den Heuvel (2009) explains that this business knowledge is constructed not only by explicit knowledge about business processes, policies and data, but also by tacit knowledge, which is very important in daily business operations.

Interoperability viewed as the ability of two or more systems to exchange information and services and to use the information that has been exchanged, with no access restrictions, or implementing, becoming one of the most important demands for enterprise. If we look at the EU's initiative for the integration of European public administration, proposed as part of the European Interoperability Framework - EIF 2.0, interoperability between public companies is one of the common goals that information systems of those companies should provide (ISA, 2010).

This paper presents the preliminary design and the procedure for enabling interoperability of a legacy 4GL system. The basic idea is to enable interoperability between public utility companies in Belgrade by exchanging models between them, transformation and execution of models. Complete procedure is illustrated in the case of complaint. In example both enterprises are involved. Basic research questions are:

- mapping between models of Web service and model of legacy 4GL system

- transformation of this mapping in execution model and calling existing Progress 4GL procedures from legacy system

The procedure is performed using a UML profile, as well as annotating Web services model in the 4GL model and then use this annotated models in the execution. For description of the Web service we used SoaML, OMG standard.The paper is organized as follows. The next section briefly presents related works from the research field. Section 3 describes the problem scenario to be analyzed. Section 4 describes the proposed solution. Following this conclusion is presented together with reference material.

2. RELATED WORK

Martin and McClure (1983) display a large list of characteristics of 4GL languages, whereby it should be noted that some of the works challenged the future, were outlined Grub and Takang (2003). Some of the benefits of these languages in the context of software maintenance are: reduction of development cost, easy understanding, automatic documentation and reduction in workload. On the other hand Grub and Takang (2003) presented a list of weaknesses of 4GL languages. *Application-Specific* - 4GLs are hard to use in a different domain compared to the one for which they were originally designed. Proprietary - 4GL environments are proprietary and incompatible with other environments and the organization cannot simply get rid of them and move on to other or similar systems. It directly affects the long-term evolution of the system. *Hyped Ease of Use* - It's adopted that the 4GL languages are very simple and that the 4GL languages designed for non-professional developers. What had once been pointed out as the main advantage, may prove to be a major weakness. This attitude leads to a big risk that the program code is unsustainable, and the system poorly designed and implemented, due to the fact that the systems will be developed by people without expertise. In this way, existing investments in 4GL systems will fail. Linthicum (1994) emphasizes that 4GL tools bind companies to software vendor, which is not standard and 4GL languages do not have sufficient flexibility, which OO languages offer and therefore they may represent the best alternative.

Interoperability has been an important area for research for years. Numerous researches and organizations propose different definitions, concepts, approaches, levels, frameworks and maturity models (ISA 2010; Berre et al 2007; Chen and Daclin 2007, Winters et al 2006, Vernadat 2010). Panetto (2007) analyzed different approaches to interoperability and classified them in relation to applications, models and standards.

Davidson et al (2001) design 4GL applications through UML models via tool VG UML Modeler. The aforementioned tool enables connection between procedural 4GL language and OO software development, with the appropriate mapping UML class in 4GL parts. The model supports the three-tier Model-View-Controller architecture.

In the context of model-driven engineering (MDE), and their motto "models are all" models can be used for transformation between models. The transformation is usually carried out in two phases. First phase defines the mapping between the elements of one model in the other. Second phase is automating the generation of the actual transformation rules. System receives two model definitions, uses rule and produces transformation (Brambilla et al., 2012). Janković et al (2012) propose approach of formal modelling cross-organizational business processes (CBP) using UML profiles.

For modelling purpose we use OMG standard for modelling Web services, SoaML. Gebhart and Bouras (2013) describe mapping rules and transformation from specification to implementation artifacts, which we use in our solution in a way that we generate additional files which describe model implementation.

Mottupalli et al (2009) design approach to SOA for Informix 4GL system, with deploying of 4GL function as Web services. W4GL tool automatically generates required skeletons, headers and wrapper files that are required. Specification of Web service is provided through configuration file. In relation to the above approach, our proposed solution is distinguished by the fact that we can combine several 4GL procedures in common communication and exchange data between them.

3. PROBLEM DEFINITION

In Belgrade, there are two public utility companies, briefly PUC. PUC "Belgrade Waterworks and Sewerage", briefly PUC BWS, specializes in production, distribution, selling and payment of consumed water and sewage services. PUC "Infostan" performs payment service for many PUC in town. We analyze the non-automated operation between companies – raise a complaint. When customer raises a complaint about the invoice and submits it to execution manually in PUC "Infostan", PUC "Infostan" archives document and forwards complaint to the PUC BWS. PUC BWS solves the complaint and informs the customer. This situation is presented in Figure 1.

Operation between two companies, raising a complaint, should be executed automatically through the Web portal of "Infostan". When customer submits a complaint on Web portal, complaint should be transferred to PUC BWS and inserted into information system of PUC BWS. This practically means that it is

necessary to enable interoperability between information systems of two PUC. We have to consider that PUC BWS use legacy 4GL IS, designed and implemented in Progress 4GL. Also, there is no possibility to switch to a new environment, it is necessary to enable executions of Progress 4GL procedures.

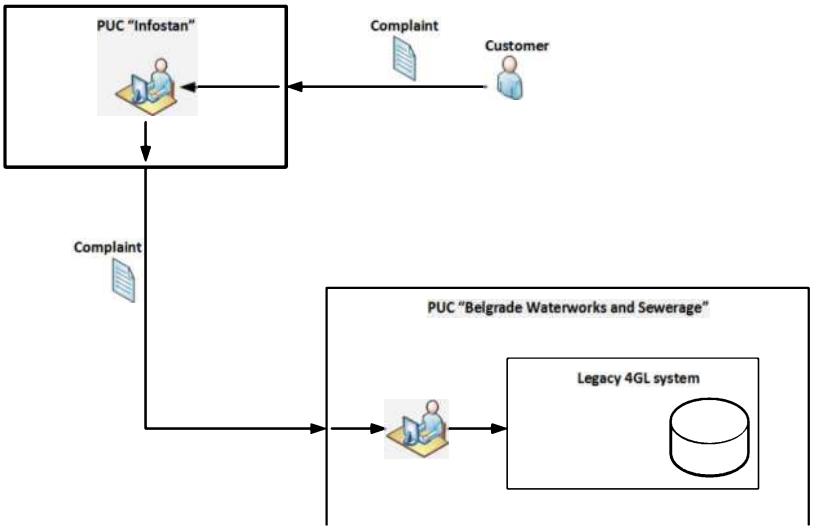


Figure 1: Current method of dealing with a complaint between companies

4GL procedure of legacy system can be exposed as set of Web services. To provide that, it is necessary to use a special tool to package and expose existing 4GL procedures, also with server which has to run existing procedures. Also, there is a need to achieve a higher degree of interoperability and exchange information between companies, and the above mentioned method can be proven as inefficient in situations which consider constant changes of existing 4GL procedures and changes in communication between Web services of two companies. It is also risky, changing existing procedures manually or programming the new ones, can prevent the legacy system from working. Such a procedure, in which we have frequently-changing ways of doing business, would require changing 4GL procedures, packaging 4GL procedures into Web services manually and the possible change in the sequence of communication between the Web services of companies.

4. SOLUTION

The proposed solution consists of several components, which are described in Figure 2.

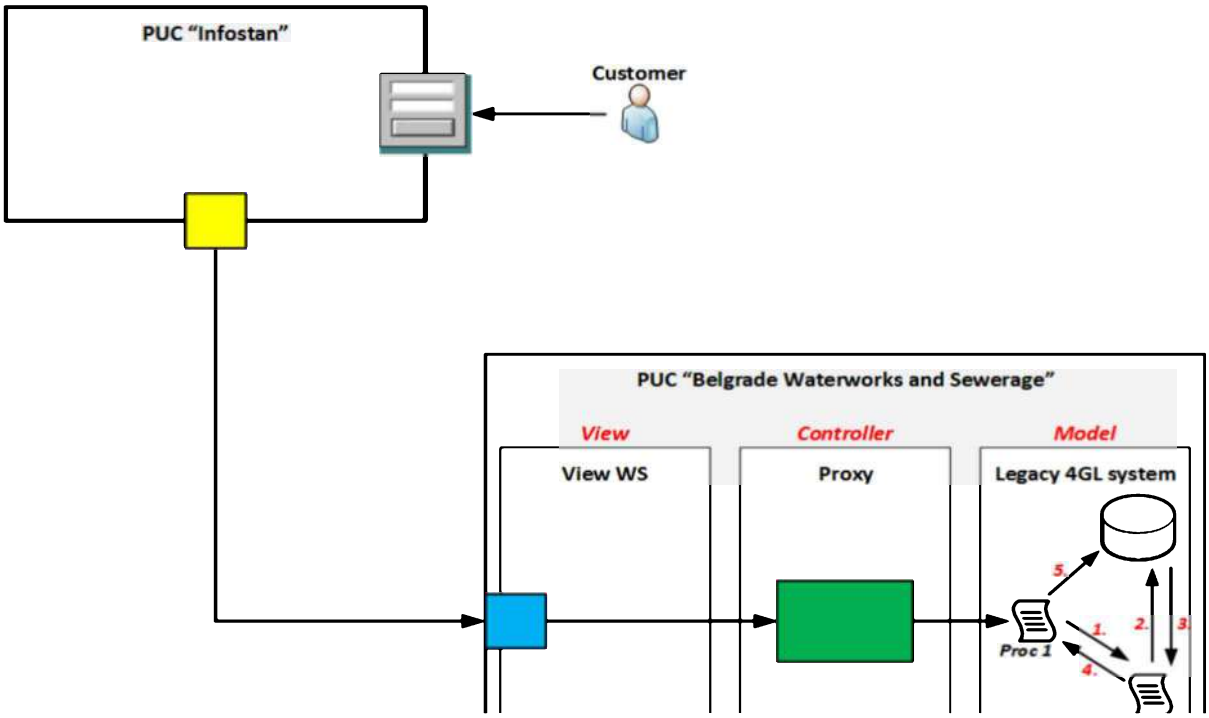


Figure 2: Proposed solution

Web service interfaces for legacy 4GL system consists of several components: ViewWS, Proxy and Legacy 4GL, which are organized according to the Model, View and Controller layers in architectural pattern Model-View-Controller, MVC. ViewWS is encapsulated functionality of legacy 4GL system, exposed to other systems as a Web service. When "Infostan" Web service forwards information about the complaint it calls ViewWS within the PUC BWS through SOAP message. In the context of MVC this component has the role of View, or the interface. Proxy is a component that accepts SOAP message from ViewWS, then make the annotation of model of Web service into 4GL and after that execute that specification from Web services into 4GL. Proxy component is the essence of the proposed project solution and the central theme of this work. Below we describe the component in a detail. In the context of MVC, this component has the role of controller.
Legacy 4GL system is existing legacy 4GL system that executes 4GL procedure. In contexts of MVC, this component has a role of Model.

Proxy Component has a role to implement the specification of annotated model Web services in 4GL model and then to execute 4GL procedures and that will way to execute business function of legacy systems. Running T2M transformation of existing 4GL procedures we can get M1 model of 4GL. M1 models of 4GL's are stored in the section Proxy component called the 4GL model Registry and it contains M1 model every 4GL procedures required for the execution of certain business functions of information system. M1 model of Web service is described by SoaML. Transformation Editor is part of Proxy component which specifies how annotation model of Web service conforms to 4GL model. After specification whole specification is memorized in WS model register component. Transformation Executor is part of Proxy component which executes specification and as result of execution procedures of Legacy 4GL systems are executed. Architecture of proposed solution is presented in Figure 3.

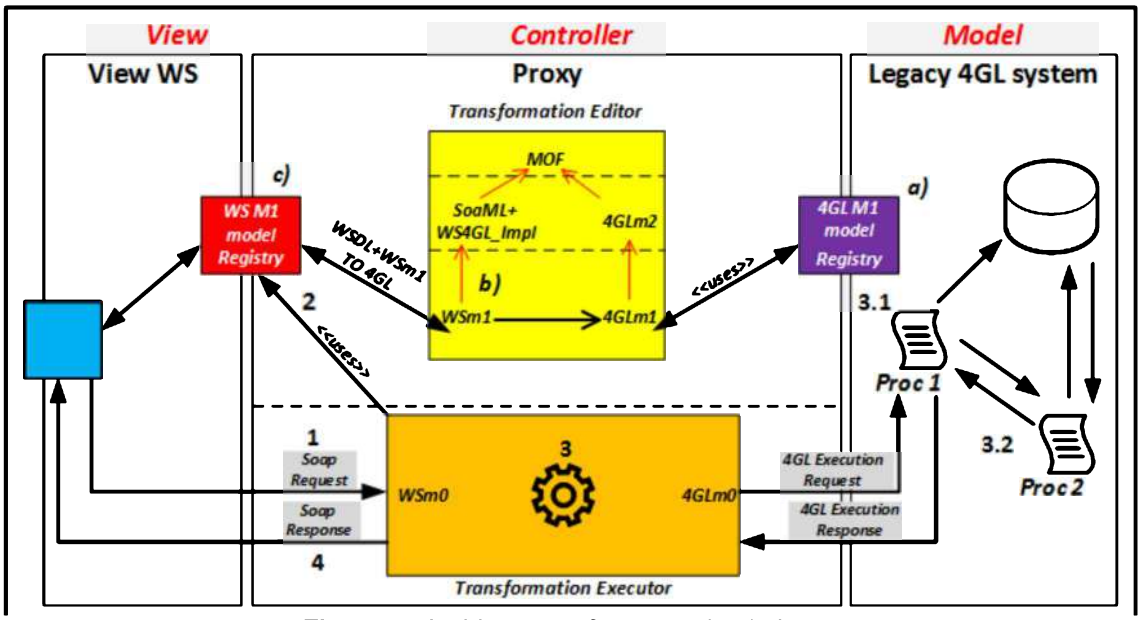


Figure 3: Architecture of proposed solution

Steps that are being carried out to build Web service interfaces for legacy 4GL system are:

1. *Service specification* – it consists of 3 steps, presented in Figure 3. and indicated as a), b) and c)

   a) *Description of 4GL procedures of legacy system and their registering into 4GL model Registry*

UML profiles used to extend the basic concepts of UML. UML profiles for 4GL are presented in Table 1.
Figure 4 displays models of two procedures from legacy 4GL system with the names CheckRegister and CreateComplaint and their attributes. Logic of 4GL procedures CheckRegister is to check whether the appropriate condition is satisfied, and if so, to call a procedure that raises a complaint - CreateComplaint and passes its parameters. CreateComplaint procedure stores Complaint into the table in Progress 4GL database of legacy 4GL system.

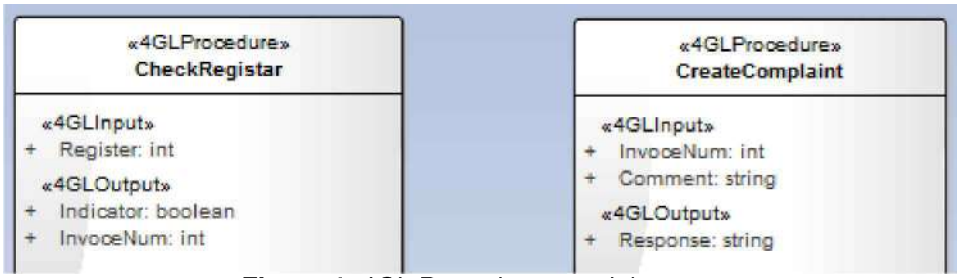
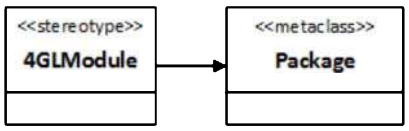
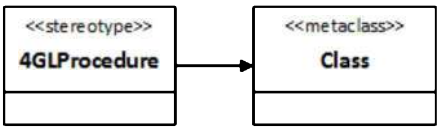
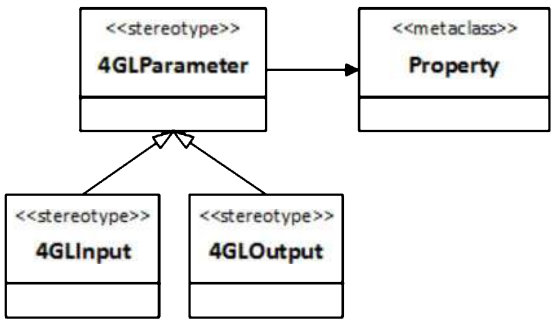


Figure 4: 4GL Procedures model

Procedures are stored in the 4GL model Registry in an automated way through T2M transformation.

Table 1: UML 4GL Profile

Stereotype	Description
	**a) stereotype: 4GLModule** Describes package which contained a set of 4GL procedures for some domains.
	**b) stereotype: 4GLProcedure** Allows to present 4GL procedure as a class. Performs a single business operation such as raising a complaint. Thus, the existing procedures are viewed as legacy systems functionality to be performed in the correct order
	**c) stereotype: 4GLParametar** Each 4GL procedure contains input and output parameters. Input parameters of one procedure can be output parameters to other procedures. Using this method, procedures are linked together.

b) the design of the implementation of Web services operations through 4GL procedure

In this part we will describe specification of Web services new part of system that needs to accept SOAP message and after that to execute functionality of legacy system, and after that to return the response to the consumer. OMG specifies UML profile for SOA to define SOA concepts inside existing UML concepts. Specification of Web services through SoaML is presented in Figure 5.

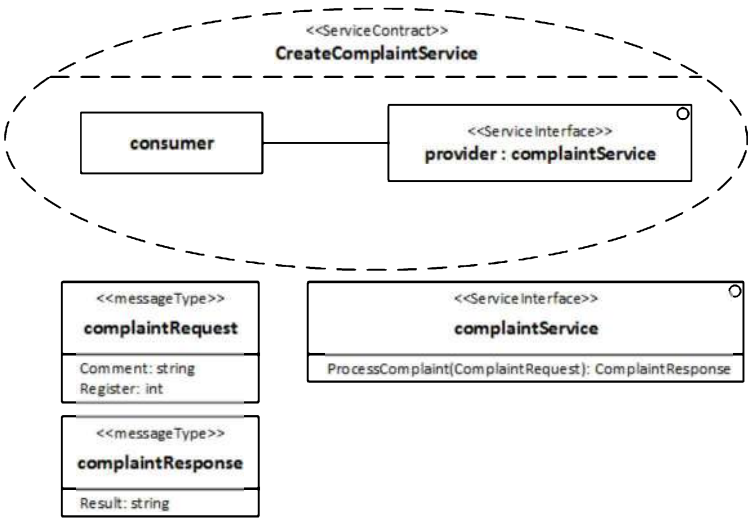
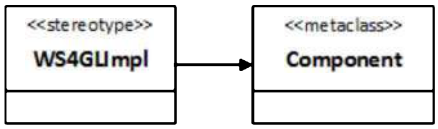
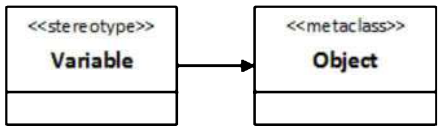
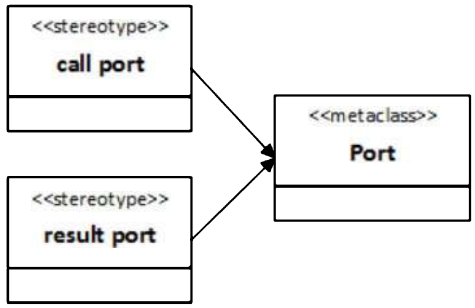
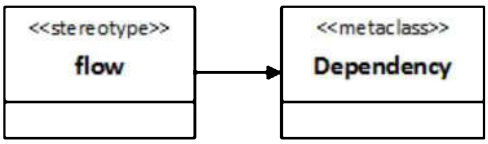


Figure 5: Specification of Web services

ServiceContract defines the conditions under which the participants in interaction must agree. Figure 5 shows that this interaction is simple and defines ServiceContract for CreateComplaintServis. In contract a consumer of Web service commits that will interact with provider, in this case complaintService. In general interaction can be more complex and include choreography, as defined in SoaML standard. MessageType describes the exchange of information between the consumer and the service. Provider calls CompliantService and send complaintRequest, which contains Comment and Register as data and as response it gets complaintResponse which contains Result. For each Web service operation it defines separate 4GL module i.e. component which presents control flow of execution registrated 4GL procedures. This description of service implementation is provided through WS4GLImp profile. WS4GLImpl profile is presented in Table 2.

Table 2: WS4GLImpl profile

Stereotype	Description
	**a) stereotype: WS4GLImpl** Indicates the component that performs 4GL procedures from the legacy system.
	**b) stereotype: Variable** Specifies the variables that will be filled with results of execution each 4GL procedures. Variables will be used for the exchange of values between procedures.
	**c) stereotype: call port** Specifies input port WS4GLImpl component. ComplaintService send message on these port. **d) stereotype: result port** Specify the output port component WS4GLImpl, which will display the result of execution flow of 4GL procedures.
	**e) stereotype: flow** Connects classes and defines execution flow of set of procedures.

Defined rules and constraints throught UML profile WS4GLImpl, which are not included in the table, allows valid specification of implementation of service with application general algorithm explained in step 2. of part *Service Execution*. Described model implementation of component which uses WS4GLImpl profile is shown in Figure 6. Diagram is created in Enterprise Architect tool. Specification implementation from Figure 6. describes how Web service ComplaintService, through operation ProcessComplaint initiates call of ProcessComplaint_Impl component and throught call port forwards complaintRequest message.

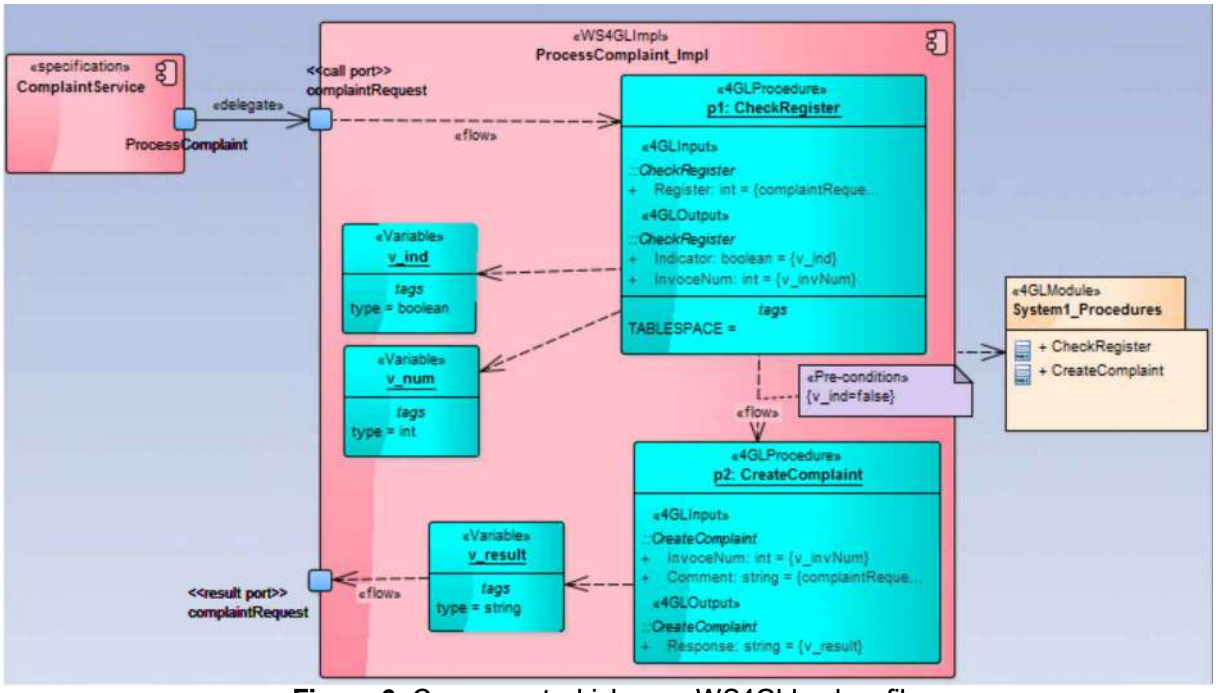


Figure 6: Component which uses WS4GLImpl profile

ProcessComplaint_Impl component takes the message, annotates the value from the message into the parameters of 4GL procedures and calls the object p1 of class CheckRegistar. The result of execution is stored in variables v_ind and v_num, in a way that object p2 of class CreateComplaint can use them. The result is memorized in the variable v_result. Web Service ComplaintServis through resultPort returns result of execution ProcessComplaint operations.

c) *check of designed model of Web services and their publishing into WS model Register*

In this step, constraints are checked with the values of input/output parameters in profiles and model is saved into WS model Register. This step is performed because model is exposed through WSDL and it is input for component which interprets that model in a runtime.

2. *Service execution* - it consists of few steps

    1. *When SOAP message arrives, there is recognition of annotated model which will be used*

    2. *Intepretation of annotated model, which is described in step b in first part Service specification, and executing actions which are described through algorithm in activity diagram presented on Figure 7.*

Interpretation of annotated models starts by finding corresponding component that executes 4GL Module, in this case WS4GLImpl. After that, the component WS4GLImpl finds the first procedure, which should call and evaluate parameters obtained from the annotated models. After that, algorithm prepares parameters, calls the procedure, accepts the result of execution and writes values into variables. Then algorithm checks is there further control flow of execution and if it exists, checks constrints, which can be defined before calling the procedure and relates to the value of the variable, which was set by previously performed procedure. If the constraint is satisified, algorithm calls next procedure. The process takes as long as procedures exists in control flow of execution. After that, algorithm is continued and prepares the response and sends it.

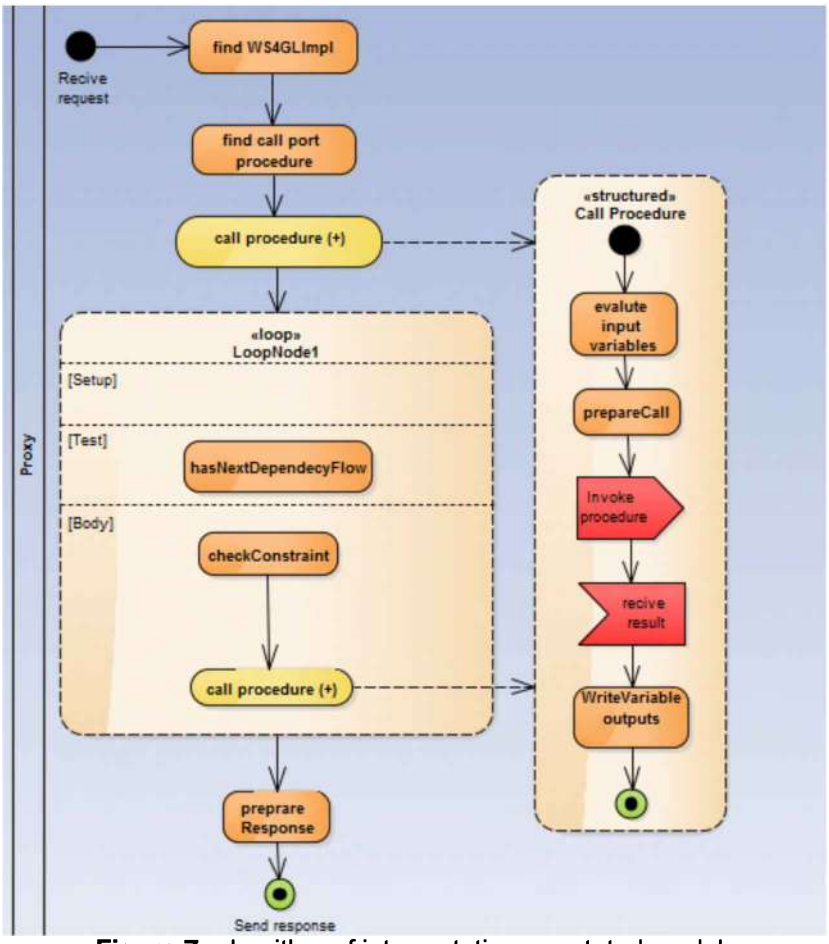


Figure 7: algorithm of interpretation annotated model

3. *component that preforms interpretation forwards response to the component which inovkes it*

Algorithm described in step 2 of Service execution is presented on an abstract level without technical implementation details of platform on which it is implemented. The task of the last activity in the algorithm is to prepare and validates the response message in accordance to specifications.

5. CONCLUSION

This paper addresses two major topics. First, it presents an approach to design Web service interface for legacy 4GL system which operates as runtime model and as such eliminates need for large number of changes in that system and also prevents potential malfunctions because of high dependencies between existing 4GL procedures. Second, it describes steps for the implementation of such an interface.

The key contributions of this paper are:

- the definition UML profile for 4GL, as specification mechanism of existing 4GL procedures
- the definition of specification Web services which calls 4GL module of legacy system, based on annotated model
- the definition of algorithm for executing that specification and calling 4GL procedures without additional changes of existing legacy system

We believe that our proposed approach is good in a situation where we want to expose modules of legacy 4GL system through proper operation of Web services, in a way that module can achieve interoperability with other system, without changing the way that existing legacy 4GL system operates. We are currently working on developing a framework to support this approach and we are experimenting with .NET development environment.

REFERENCES

Berre, A., Elvesæter, B., Figay, N., Guglielmina, C., Johnsen, S., Karlsen, D., Knothe, T., & Lippe, S. (2007). The ATHENA interoperability framework, In R. J. Gonçalves, J. P. Müller, K. Mertins, & M. Zelm (Eds.), *Enterprise Interoperability II*, 569-580. London: Springer-Verlag London Limited. doi:10.1007/978-1-84628-858-6_62

Brambilla, M., Cabot, J., & Wimmer, M. (2012). *Model-Driven Software Engineering in Practice.* Publisher: Morgan & Claypool Publishers. DOI: 10.2200/S00441ED1V01Y201208SWE001

Chen, D., & Daclin, N. (2007). Barriers Driven Methodology for Enterprise Interoperability, In L. Camarinha-Matos, H. Afsarmanesh, P. Novais, & C. Analide (Eds.), *Establishing the Foundation of Collaborative Networks*, 243, 453-460. IFIP, NY: Springer.

Davidson, S., Keren, M., Porat, S., & Zodik, G. (2001). Designing Procedural 4GL Applications through UML Modeling. In *Workshop of the pUML-Group held together with the «UML»2001 on Practical UML-Based Rigorous Development Methods - Countering or Integrating the eXtremists*, 69-85.

Grubb, P., Takang, A. (2003). *Software Maintenance: Concepts and Practice* (2nd ed.). Singapore: World Scientific Publishing Co Pte Ltd

Gebhart, M., Bouras, J. (2013). Derivation of Web Service Implementation Artifacts from Service Designs Based on SoaML, In *International Journal on Advances in Software*, *6*, 170-180.

Interoperability solutions for European public administrations. (2010). *European Interoperability Framework (EIF) for European public services - Annex 2*, Retrieved from: http://ec.europa.eu/isa/documents/isa_annex_ii_eif_en.pdf

Janković, M., Ljubičić, M., Aničić, N., & Marjanović, Z. (2014). Enhancing BPMN 2.0 Informational Perspective to Support Interoperability for Cross-Organizational Business Processes. Paper presented at the *4th International Conference on Information Society and Technology (ICIST 2014)*.

Linthicum, D. (1994). 4GLs: No easy answers. *Object Magazine 4(5)* 38-42.

Martin, J., & McClure, C. (1983). *Software Maintenance – The Problem and Its Solutions*. New Jersey: Prentice Hall

Mottupalli, S., Maheshwari, G., & Mahadevaiah, T. (2009) *Deploy 4GL functions as Web services*. Retrieved from: http://www.ibm.com/developerworks/data/library/techarticle/dm-0902mottupalli/dm-0902mottupalli-pdf.pdf

Panetto, H. (2007). Towards a Classification Framework for Interoperability of Enterprise Applications. In *International Journal of Computer Integrated Manufacturing, 20(8)*, 727-740. PA: Taylor & Francis

Sommerville, I. (2008). *Supplementary material with book Software Engineering.* Retrieved from: http://ifs.host.cs.st-andrews.ac.uk/Books/SE9/Web/LegacySys/index.html

van den Heuvel, W. (2009). *Aligning Modern Business Processes and Legacy Systems: A Component-Based Perspective*. MA: The MIT Press.

Vernadat, F. (2010). Technical, semantic and organizational issues of enterprise interoperability and networking, In *Annual Reviews in Control*, *34*(1), 139-144.

Winters, L., Gorman, M., & Tolk, A. (2006). Next Generation Data Interoperability: It's all About the Metadata. Paper presented at the *Proceedings of Fall Simulation Interoperability Workshop*.

OMG (2012). *SoaML*. Retrieved from http://www.omg.org/spec/SoaML/1.0.1/PDF/

INTERNATIONAL MANAGEMENT 815

GAINING COMPETITIVE ADVANTAGE IN INTERNATIONAL BUSINESS ENVIRONMENT THROUGH SMART PRODUCTS AND SERVICES DEVELOPMENT 816
Backović Nemanja, Milićević Vesna, Ilić Bojan

INTERNATIONAL SOURCES OF FUNDING ECONOMIC DEVELOPMENT 824
Jednak Sandra, Parežanin Miloš, Kragulj Dragana

TRANSFER PRICES - AN INSTRUMENT FOR BOOSTING COMPETITIVENES OF MULTINATIONAL ENTERPRISES 832
Popovčić-Avrić Snežana, Šestović Marina, Todić Tamara

ROMANIA AND SERBIA – SIMILARITIES AND MAJOR DEVIATIONS FROM THE STATISTICAL PROFILE OF A GENERIC BALKAN ECONOMY 838
Săvoiu Gheorghe, Taicu Marian, Čudanov Mladen

INTERNATIONAL TECHNOLOGY TRANSFER AND SPILLOVERS IN MERGERS AND ACQUISITIONS 847
Kijanović Nemanja

OVERVIEW OF AIRLINE FLEET OWNERSHIP STRUCTURE 854
Dožić Slavica, Krnić Radovan

INTERNATIONAL MANAGEMENT

GAINING COMPETITIVE ADVANTAGE IN INTERNATIONAL BUSINESS ENVIRONMENT THROUGH SMART PRODUCTS AND SERVICES DEVELOPMENT

Nemanja Backović[1], Vesna Milićević*[1], Bojan Ilić[1]
[1]Faculty of Organizational Sciences, University of Belgrade
*Corresponding author, e-mail: vesmil@fon.rs

Abstract: *This paper analyzes the role of smart products and services with the view of their impact on competitiveness of company in international business environment. The paper reviews the importance of systematic organizational learning and dynamic capabilities development for smart business activities and overall performance. Strategic planning is observed within regional business units and how the flow of feedback information creates advance level of expertise. The emphasis is on the cross-department interaction and knowledge transfer for extensive capabilities of products and services formation. The efficiency is obtained through future oriented flexible adjustments, alongside with component knowledge for total product quality and intense responsiveness. Relevant examples show how successful smart systems expand their complex business networks and how they reshape management structure in accordance with international market demand. Smart products and services progress is examined in terms of increasing long term competitive advantage in international business. Accumulation and deployment of crucial resources are viewed as a result of effective knowledge articulation and superior operating routines. The paper also evaluates current strategies and possibilities of new business models for smart organizational learning as a perspective source of sustainable development.*

Keywords*: international management, smart products and services, competitiveness, multinational corporations, profit, dynamic capabilities, strategic planning*

1. INTRODUCTION

Creating competitive advantage by placing smart products and by providing smart services is a modern approach to business of enterprises oriented to future business success in an international environment. Business strategies, organizational skills and an entrepreneurial approach to solving business problems are relevant to the new system of managing companies' development. Consideration of the learning process based on experience and finding alternative options is viewed through the concept of organization that continuously generates new knowledge. Smart products and services require advanced structure, decentralization of the parent company and decomposition of the value chain based on business functions. The role of strategic business units is also significant, as they are in terms of the knowledge-based economy viewed as centres of responsibility and feedback information. In this context, the flow of information and improving all product components individually create competitive advantage based on efficient adaptation to market conditions. Long-term relationships with subcontractors, together with the perspective of investment in foreign markets, develop new sources of sustainable development of enterprises.

Business units autonomy based on the principle of loose structure of the company encourages creative solutions and helps protecting innovative ideas for upgrading the existing production facilities. The theoretical framework suggests the importance of delegating authority to lower levels of management and informal communication with superiors from the parent company. Incremental improvements in the vertical value chain and diversification of production form the basis for successful development of smart products and services. Equal distribution of dynamic manufacturing capabilities and absorption of relevant management skills strengthen the competitiveness of the entire organization, with an emphasis on operation efficiency. Meeting the needs of consumers stands out as a very important area, as evidenced by the fact that users of smart products and services are given special attention by reconfiguration of the products during the design phase. Strategic decisions at the enterprise level are adopted in accordance with the needs of local markets, which implies the emergence of a dynamic framework of organizational evolution of resources, capabilities and knowledge. Support to production sequence by complex coordination of activities and inclusion of non-routine management decisions creates a strong competitive advantage of the company to the resource-based approach (Helfat & Raubitschek, 2000).

2. COMPETITIVE ADVANTAGE AND SMART PRODUCTS DEVELOPMENT IN CONTEMPORARY INTERNATIONAL MANAGEMENT

Business enterprises in contemporary conditions of intensive competition require a flexible approach to the organization of business processes and decentralization of business units on the principle of lateral communication. The growth of value for international consumers by disruptive access to integrated business operations imposes the necessity of realization of strategic business objectives at the level of technologically rounded units of the company. Products at higher processing level are becoming the source of competitive advantage, with a focus on more efficient use of operating capital, increasing inventory turnover ratio, reducing product obsolescence, strengthening the responsiveness of consumers and other relevant factors. The integration of domestic and global business operations is achieved by standardizing business processes, improving operational performance and efficiency by using "pull" strategy, with the aim of taking advantage of economies of scale and aligning the physical capital of the company with the needs of the local market.

By providing specific and advanced services, a company is focusing on the value that its products can achieve in a competitive market and a long-term relationship of trust with consumers. Modern business model is transformed from the business philosophy of "value is in the product" to the modern concept of "value in the service that the product provides", thus obtaining a "return value" from satisfied customers. For active participation of consumers in creating a generic value chain the term *prosumer* is used in international management.

In the context of strategic planning, orientation to stabilizing the business and better positioning in the market has resulted in the "outward-in" management approach in the movement from the analysis of external environment to the analysis and adjustment of the company's internal environment (Davenport, Leibold & Voelpel, 2006). Bearing in mind that in terms of global business discontinuity accurate predictions of future market trends are hard to attain, incremental improvements in operations and expansion of business opportunities are considered to be insufficient to create a competitive advantage in foreign markets. Consequently, new strategies are needed to encourage dynamic capabilities of enterprises on the basis of continuous learning about the needs of the open business system. The acceptance of complex and interdependent network of intra- and inter- relationships of the companies is necessary in order to adapt the product to specific and individual needs of consumers and to incite changes in the organizational sense.

The development of smart products and services requires a significant change in the strategic approach to business and reshaping of the phases in terms of evolving enterprise management. Data exchange between business eco-systems and external sources of competence serves as a platform to support new technological infrastructure of the company. Combination of data controlling and the possibility of remote supervision of business processes creates new opportunities for business optimization in a broader sense (Porter & Heppelmann, 2015). The variety of smart products and services is also cost-effective, bearing in mind that the software engineering tools are changing the physical components of the product. Special attention is given to the interconnected system of production, in which the placement of related products is based on the relationship of trust with subcontractors, with special emphasis on system interoperability.

Analytical approach to creating business databases strengthens the expertise and facilitates communication between business units. Shorter development cycles of new smart products and services affect the responsiveness of the local markets to the approach of production integration and differentiation, with an emphasis on continuous improvement of the modification process of new product. In addition, smart products are designed according to the concept of voluntary exchange of information, which fosters consumer loyalty, facilitating further analysis of user preferences (Cronin, 2010). A new attitude towards certain other external stakeholders also becomes prominent (Milicevic, 2014).

Holistic approach to business eco-system consists of an efficient joining of resources, cooperation with business partners, suppliers and consumers in order to educate the established business networks based on organizational values, dynamic capabilities and company profitability. The principle of entropy, which originates from the field of thermodynamics, can describe the loss during the process of knowledge and information transfer within the company, according to which the ability of a business model to provide competitive advantage will decline due to pressure from uncontrolled market forces (Davenport, Leibold & Voelpel, 2006). Consequently, business eco-system must be able to continuously adapt to new market conditions in knowledge-based economy, related to "increasing returns". Thus, in modern international business an enterprise is considered to be an integrated business entity if it is made up of separate business units, which often include operations in different industries.

Smart product can be viewed as a series of post-added features in the process of the development of production line, which increases its usability and functionality. In other words, the competitive advantage of smart products and services is viewed from the aspect of dynamic approach of value creation, as opposed to the conventional model of achieving competitive advantage on the basis of the final production program (Annacchino, 2007). This offers new opportunities for growth of companies with a high degree of adaptive capacity. Managers should aim at accelerated growth in profit per product unit based on the uniqueness of the product, while the scale of business should gradually grow with the tendency of decreasing fixed costs per unit. When creating competitive advantages of smart products and services worldwide, managers should take into account the complexity of internal and external influences on the international competitive advantage of firms and the essence of sustained competitive advantage (figure 1).

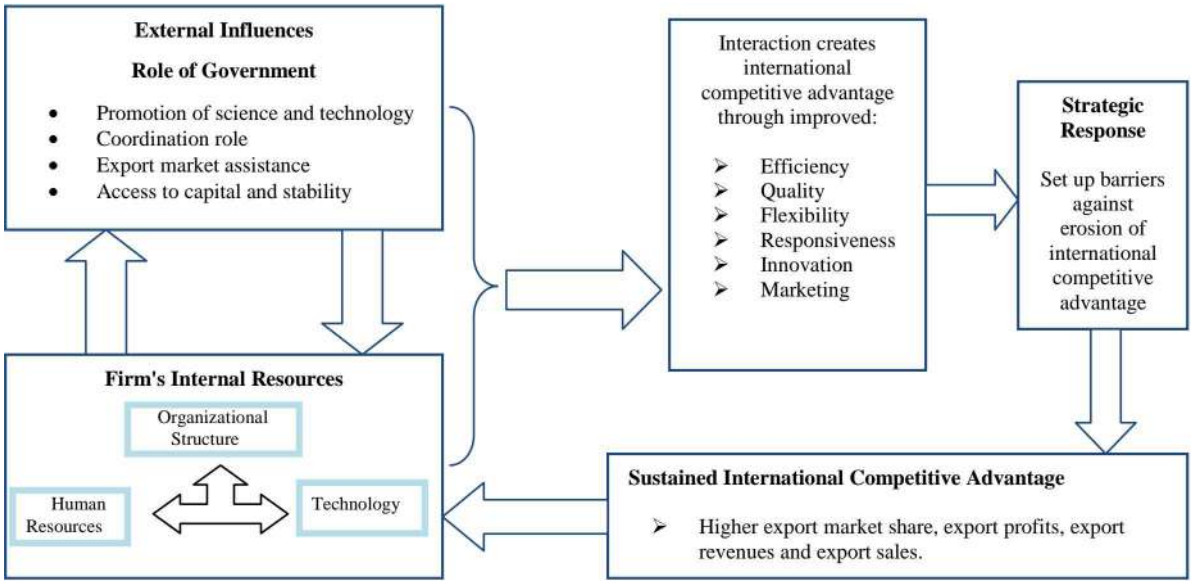


Figure 1: Internal and external influences on the international competitive advantage of firms
Adapted from: Chadee & Kumar (2001), p. 464

3. ORGANIZATIONAL LEARNING AS A SOURCE OF COMPETITIVENESS

Multinational corporations play a dominant role in present global market, considering the fact that the top 200 corporations combined sales were “bigger than the combined economies of all countries, minus the biggest 10” (Anderson & Cavanagh, 2000). This data implies the impact that globalisation has on all aspects of today's business landscape, and by that it emphasizes the importance of future intra-firm correlations. Here we must point out that the globalisation influences substitution of traditional assets in exchange for factors of paramount importance to the multionational corporations, where most crucial are technology, knowledge and capital (Demirbag & Glaister, 2010). These three factors are certainly the main causes for existence of competitive advantage. Nevertheless, they cannot be integrated into corporations operation processes if there is a lack of managing capability. According to that, the firm has to maintain and enhance its internal capabilities by learning from its own operations and by absorbing knowledge outside the firm (Andersson, 2003).

Capability can be defined as “the firm's capacity to deploy resources for a desired end result” (Capron & Mitchell, 2009). Therefore, it is essential to achieve quantity and quality overlap of these know-how and know-what sources. Several scholars have researched and empiricaly tested significance of capability transfer, as a genuine raison d'être of multinational corporations (Holm & Pedersen, 2000). Although there are various relevant studies that are built around premise of top-down capability flow (Porter, 1990), there are still only few studies concerning reverse-based relationship between headquarters and subsidiaries, especially in-between developed countries and countries in economic transition (McGuiness, Demirbag & Bandara, 2013). Giving the interest rate for this topic and its importance to firm's future organizational framework, it is vital to accentuate main reasons that could impact transfer of capabilities in a reverse based form. This contemporary management concept is particularly important for further smart products component development, as the dissemination of knowledge is used for establishing vital firm competencies.

Important aspect of capabilities development is subsidiary's absorptive capacity, which stands in correlativity with multiple factors. Furthermore, we can "assume that resources are limited, which means that the more engaged a subsidiary is in absorbing external knowledge, the less resources it is likely to allocate to interaction with its own sister unit" (Andersson, 2003). As a result, absence of developed transfer network generates knowledge-based diseqaulity, that eventually slows down integration process in foreign markets. Because of that, corporate management must be able to transfer available competence within subsidiaries, especially in market discontinuity conditions.

Even though empirical studies suggest that a transfer of capabilities is less difficult and more efficient within intra-organizational units (Zander & Kogut, 1995), some scholars specify several obstacles, recognizing that a transfer is not just an act, but a long-term process (Szulanski, 2000). On the basis of this empirical data, we can assume that "capability-development problems primarily arise from implementation difficulties, rather than from selection mistakes" (Capron & Mitchell, 2009). This acknowledgement refer us to several complex questions regarding intensity of intra-firm correlation and its effects on firm's productivity. Answers to these questions depend on the set of subsidiary characteristics.

High-order dynamic capability relevant for smart products and services strategies enables companies to develop lower-order partnering skills to manage different phases in alliances more efficiently (Kale & Singh, 2007). By accumulating and applying knowledge, organization deliberately articulate company's know-how in order to undertake complex tasks more systematically. Considering managerial aspects of providing smart products to new business environment, it is especially significant to emphasize the role of knowledge sharing and personal interactions between individuals. Absorption of learning process is associated with extraction of valuable task-related skills that involve proactive usage of available resources. This process provides then more ability for internationalization mechanism to be applied. The focal point of coordination is to share best practices within the company, that result in competitive advantage obtained through dynamic model of strategic product sequencing.

Adapting business processes to changing market conditions requires explicit dynamic framework, that tracks stages of organizational evolution through time (Helfat & Raubitschek, 2000). Knowledge that integrates in several stages of vertical chain demands advance management of codified information about smart products and services and research on how they affect other activities in company. This mechanism allows company to gain knowledge about their customers' needs and to give an upper hand for associated business activities. By doing so, company may introduce diversified portfolio of products and services in a separate market and therefore enhance horizontal expansion (Huang, Chang & Henderson, 2008). The possibility for replacement products utilization of manufacturing techniques and previous integrative knowledge could also lead to economies of scope, explaining how two systems of learning function within production sequencing. If separated, these two system would consist out of incremental learning and step function learning (Helfat & Raubitschek, 2000).

Incremental learning is referred to as a dynamic capability process in which company gains competitive advantage from accumulation and deployment of resources (Zollo & Winter, 2002). The systematic enhancement of intangible resources increases company's flexibility to set up smart services for new customers. In the value creation chain intuiting and interpreting acquired knowledge are essential elements at a micro level. Furthermore, it should be pointed out that incremental learning does not depart from current knowledge, but it emphasizes contemporary alterations of products and services with a view to generate growth of cumulative volume. Hence, customer can easily provide information about products characteristics and performances, which could be directly linked to business process modification and flexible adjustments strategy based upon clients' feedback. Thereby, incremental learning is becoming more path dependant and user oriented as specific products and services evolve (Kvalshaugen, Lowendahl, Skojlsvik & Fosstenlokken, 2006). With regard to product sequencing over the period of time, existed, assimilated and applied knowledge is underlying the smart product while there are closely linked to one another. The expected outcome is effective interdepartmental communication that results in progress of core capabilities for smart organizational evolution. Some companies, as for example *Suzlon Energy Limited* (Indian wind energy company), even reorganize entire business divisions by creating "operation and maintenance service" that allow them independent growth in different market of the world, which further promoted flexible approach (Backović, Ilić & Milićević, 2016).

In accordance with difficult challenges of new international business environment, some markets demand learning based upon on-going feedback mechanism that signal potential need for rethinking major areas of supply chain. Thus, step function learning involves recognizing the permanent dedication to merge core and integrative knowledge in order to reshape smart products and services in initial development phase. It is obvious that "one-size-fits-all" solution is not available, considering that adjustments are made during production process and that they are creating substantial differential company's success. By obtaining

information about shift in customer desires, alongside with benchmarking of competitors, organization effectively adapts to product sequencing within markets and across the value chain. A richer set of real options and product platforms form superior system of learning that is highly differentiated due to path dependence of new product and service learning process (Helfat & Raubitschek, 2000). Following these patterns, short term competitive advantage is converted into long term company's success. Co-evolution of reshaped knowledge and smart products in technology-intensive industries is a foundation for fundamental resource and capability expansion into different product markets. The logic behind this assumption relates to note that product is divided into multiple components that are analyzed individually under the architectural knowledge of various production stages (Zott & Amit, 2008).

Integrated circuit technology, as a basis for semiconductor chips, was a beginning of component knowledge which is emphasized across the vertical chain. This enables management to recognize potential threats and opportunities in the new business environment and to use tacit knowledge to conjoin organizational mechanism. Smart structures are developed from current system to understand the causal ambiguities surrounding a new technology, and are brought up to the forefront of strategic planning thinking. The new insights suggest that it is vital that major part of those capabilities stay within the company, as empirical studies indicate that greater outsourcing for business process enhancing technologies lowers a firm's integrative capabilities and performance in the market (Weigelt, 2009). Effective operating routines that involve experience accumulation, knowledge articulation and knowledge codification, alongside with superior operating routines of acts of creativity are sources of competitive advantage for extended period of time (Zollo & Winter, 2002). The degree of causal relationships clarity is also relevant for performance implications of specific subtasks actions.

A coherent organizational structure interact with the numerous learning patterns, which is why it is significant to avoid distorted versions of knowledge exchange, especially during managerial decisions for new product markets. Stable and reliable infrastructure is highly beneficial for companies with a high proportion of export sales from digital and remote-controlled services, that allow downstream activities to be offered independent of location (Lerch & Gotsch, 2015). The intangible assets have far-reaching consequences for customer oriented solutions, so it is expected they will create an external digital environment with the view of competitiveness increase. Gaining advantage will emerge from more customized products and services and intensive responsiveness on local markets. Managing value based activities in collaborative business networks through application of ecosystem models configurates company to continually sustain and reinvent itself to satisfy the multiple objectives of its various stakeholders (including shareholders) (Davenport, T., Leibold, M. & Voelpel, S., 2006). In order to compete in a well-defined industry, smart learning company has to construct disruptive business approach that magnify differences for discovering new ideas in dynamic nonlinear systems. Therefore, "an enterprise should simultaneously manage a family of incubating (being formed), experimental (being tested in the market place), and significantly reinvented (e.g., incrementally innovated) business models" (Davenport, Leibold & Voelpel, 2006).

4. THE RELEVANCE OF SMART PRODUCTS AND SERVICES FOR SUCCESSFUL INTERNATIONAL BUSINESS

Smart products and services built on dynamic capabilities and continuous learning process are difficult to imitate and create signature components for outstanding level of profit and, consequently, long term effectiveness. Well developed, idiosyncratic systems exclude a threat of innovation diffusion to other companies by constant modification of guiding strategies and policy. Entrepreneurial activities within dynamic capabilities are conducted by "identifying undersatisfied demands and mobilizing resources in such a way as to profit from satisfying them" (Teece, 2014, p. 335). It is important to highlight that these capabilities are not influenced by purpose of the product or service itself, but can be reused for similar purposes. The exceptional value for well-delineated tasks is what distinguishes smart strategies from ordinary one. Several advanced examples point out the relevance of smart products and services for competitive advantage and successful internationalization of core business activities.

Netflix, as one of the most successful online movie rental services in the world, revolutionized the movie rental business model, capturing approximately 33.3 million subscribers and offering nearly 100.000 movies and other entertainment videos to their customers (Hitt, Ireland & Hoskisson, 2009). Facing emerging competitors called "video on demand" business networks where the movie is viewed in real time, Netflix creates its competitive advantage by providing high quality smart services to clients for below average costs (18 US$ per subscriber), establishing partnerships with video recorder companies, investing vast amount of financial means for online advertisements and by running ads on the mainstream media networks (Hitt, Ireland & Hoskisson, 2009). Because Netflix is an online entity, it must have capability and foresight to manage extensive growth to maintain its stronghold position. Considering rapid expansion of its distribution

network, Netflix has an ability to compete effectively and to provide quick deliveries to dramatically growing subscriber base.

Sony Corporation is an impressive example of well-coordinated subsidiary initiatives and lucrative managerial actions, as parts of wider strategic context of devoting special attention to most successful regional business units and promoting functional and operational autonomy. Sony's management converted product-centred networks into solution-oriented companies by regrouping them into seven companies and allocating resources under the new management platform (Frynas & Mellahi, 2015). With the strategy of integrative learning called "four-network gateway", Sony managed to combine hardware and service businesses so that subsidiaries as centres of excellence could, with innovative products and fast paced information feedback, effectively control this over-diversified conglomerate company. Radical restructuring of divisions enforced cross-department collaboration and break down of the barriers between independent units. Sony removed overlapping business processes and focused on high growth businesses, such as UHD, 4K and 3-D technology, while forming two major groups inside the company: the "Consumer, Professional and Devices" group and "Network Products and Services" group (Frynas & Mellahi, 2015). Sony's step function learning has established strong link among smart products and services found on feedback from consumers, feedback from partner companies and integrative knowledge that facilitate these advantages. With products such as Smart Tennis Sensor, smart B-Trainer and SmartWear Sony has integrated several vital functions for inspiring ways of exploring new connection and communication devices (Sony Corporation, 2016). Sony's smartphone "Xperia" strategy rethinks flagship devices introduction to meet market requirements and to reach outstanding performance in midrange price section.

Integrating various features into smart products and services as a management tool for promoting overall production quality and reducing maintenance costs has been key to success of Huawei Technologies. Set up from a three-level technical support system, Huawei is a Chinese telecommunication company that offers total network products and end-to-end solutions based on its experience in technology and applications (De Toni, 2011). The most important component for Huawei regarding customers' needs is its application specific integrated chip. Highly skilled managers are committed at the two ends on research and development and market needs, representing typical knowledge-based firm. Huawei also gives special effort to promote component based system of interactive learning and to simplify the organizational structure and thereby to put an end to technology "leakage". Regional headquarters are established as a business philosophy of developing national industry instead of focusing on joint ventures with foreign investors (De Toni, 2011). Sustaining superior performance in fast moving global environment and transformational leadership are of great importance for Huawei's business identity. It is important to emphasize that Huawei is an example of outstanding diversification, having in mind that it is seeking to reduce their reliance on mobile phone industry and to increase strength in adjacent markets. "FusionSolar Smart PV Solution" incorporates accumulated knowledge and expertise in digital information technology, Internet technology and PV (Photovoltaics) technology. Huawei supports investors to maximize return on investment and other financial ratios within the solar power plant life cycle by enabling high-speed components applicable to various environments (Huawei Technologies Co. Ltd, 2016).

5. CONCLUSION

The analysis presented in this paper shows the significance of the development of smart products and services to a modern company, with special reference to the conditions of international business environment discontinuity. Investing in the business processes of technologically advanced systems is a challenge for the international management and imposes the need for adapting the basic functions of business to the new, holistic concept of creation. Free and efficient flow of knowledge between highly differentiated strategic business units generates competencies based on adaptive and proactive organization's ability to continuously evolve. Disruptive business models effectively allocate and employ resources to upgrade components of smart products and connectivity of services portfolio. Strategies of incremental and step-function learning have special significance for the stable growth of production, adapting services to the needs of users and gaining competitive advantages. Dynamic development opportunities depend on the change management and the ability to timely market products and services.

Research in the context of modern international management of smart products and services indicate the emergence of an integrated approach to understanding the capabilities of the company. Further development and technological completeness of strategic and regional business units is expected, where interactive relationship based on knowledge economy will have a major role in increasing the efficiency of the business entity as a whole. The decentralization strategy with clear restructuring will establish the necessary degree of autonomy in local business markets, with control by the parent company. Flexible customization of smart products and services to the needs of international consumers will create long-term stability of

companies' growth, focusing on the competitiveness derived from the improved management actions and commitment to preserve the existing benefits of the products and services, but also to create new advantages in international terms for future success.

REFERENCES

Anderson, S., & Cavanagh, J. (2000). *Top 200 – The Rise of Corporate Global Power*. Retrieved April 2nd, 2016, from http://www.rrojasdatabank.info/top200.pdf

Andersson, U. (2003). Managing the transfer of capabilities within the multinational corporations: the dual role of the subsidiary, *Scandinavian Journal of Management* 19 (4), 425-442.

Annacchino, M. (2007). *New Product Development – From Initial Idea to Product Management*, New York: Elsevier.

Backović, N., Ilić, B., & Milićević, V. (2016). The Importance of Wind Energy Economic Efficiency for Sustainable Development, 35th International Conference on Organizational Science Development, Portorož, Slovenia, 31-40.

Capron, L., & Mitchell, W. (2009). Selection Capability: How Capability Gaps and Internal Social Frictions Affect Internal and External Strategic Renewal, *Organization Science* 20 (2), 294-312.

Chadee, D., & Kumar, R. (2001). Sustaining the International Competitive Advantage of Asian Firms: A Conceptual Framework and Research Propositions, *Asia Pacific Journal of Management* 18 (4), 461-480.

Cronin, M. (2010). *Smart Products, Smarter Services – Strategies for Embedded Control*, Cambridge: Cambridge University Press.

Davenport, T. H., Leibold, M., & Voelpel, S. (2006). *Strategic Management in the Innovation Economy*. Erlangen: Publicis and Wiley.

De Toni, A. (2011). *International Operations Management – Lessons in Global Business*, Burlington: Gower Publishing Company.

Demirbag, M., & Glaister, K., W. (2010). Factors determining offshore location choice for R&D projects: A comparative study of developed and emerging regions, *Journal of Management Studies* 47 (8), 1534-1560.

Frynas, J., & Mellahi, K. (2015). *Global Strategic Management*, Oxford: Oxford University Press.

Helfat, C., & Raubitschek, R. (2000). Product Sequencing: Co-Evolution of Knowledge, Capabilities and Products, *Strategic Management Journal* 21 (10-11), 961-979.

Hitt, M., Ireland, R., & Hoskisson, R. (2009). *Strategic Management Cases – Competitiveness and Globalization*, Mason: South-Western Cengage Learning.

Holm, U., & Pedersen, T. (2000). *The Emergence and Impact of MNC Centres of Excellence*, London: Macmillan Press.

Huang, C., Chang, H., & Henderson, S. (2008). Knowledge Transfer Barriers Between Research and Development and Marketing Groups within Taiwanese Small- and Medium sized Enterprise High-Technology New Product Development Teams, *Human Factors and Ergonomics in Manufacturing* 18 (6), 621-657.

Huawei Technologies Co. Ltd (2016). Retrieved April 4th, 2016, from http://www.huawei.com/en/all-products/Solar/Solution

Kale, P., & Singh, H. (2007). Building firm capabilities through learning: the role of the alliance learning process in alliance capability and firm-level alliance success, *Strategic Management Journal* 28(10), 981-1000.

Kvalshaugen, R., Lowendahl, B., Skojlsvik, T., & Fosstenlokken, S. (2006). Incremental Learning in Professional Service Firms: The Importance of Project and Client Characteristics. Retrieved March 20th, 2016, from http://www2.warwick.ac.uk/fac/soc/wbs/conf/olkc/archive/olkc1/papers/296_kvalshaugen.pdf

Lerch, C., & Gotsch, M. (2015). Digitalized Product-Service Systems in Manufacturing Firms, *Research-Technology Management* 58(5), 45-52.

McGuinness, M., Demirbag, M., & Bandara S. (2013). Towards a multi-perspective model of reverse knowledge transfer in multinational enterprises: A case study of Coats plc, *European Management Journal* 31(2), 179-195.

Milićević, V. (2014). *Strategijsko poslovno planiranje, menadžment pristup*, Beograd: Univerzitet u Beogradu, Fakultet organizacionih nauka.

Porter, M., & Heppelmann, J. (2015). How Smart, Connected Products are Transforming Companies, *Harvard Business Review* 93(10), 96-114.

Porter, M. (1990). The Competitive Advantages of Nations, *Harvard Business Review*, 68(2),73-93.

Sony Corporation (2016). Retrieved March 31st, 2016, from http://www.sony.co.uk/electronics/mobile-phones-tablets-smart-wear

Szulanski, G. (2000). The process of knowledge transfer: A diachronic analysis of stickiness, *Organizational Behavior and Human Decision Processes* 82(1), 9-27.
Teece, D. J. (2014). A dynamic capabilities-based entrepreneurial theory of the multinational enterprise, *Journal of International Business Studies* 45(1), 8-37.
Weigelt, C. (2009). The Impact of Outsourcing New Technologies on Integrative Capabilities and Performance, *Strategic Management Journal* 30(6), 595-616.
Zander, U., & Kogut, B. (1995). Knowledge and the speed of the transfer and imitation of organizational capabilities: an empirical test, *Organization Science* 6(1), 76-92.
Zollo, M., Winter, S. (2002). Deliberate Learning and the Evolution of Dynamic Capabilities, *Organization Science* 13(3), 339-351.
Zott, C., & Amit, R. (2008). The Fit between Product Market Strategy and Business Model: Implications for Firm Performance, *Strategic Management Journal* 29(1), 1-26.

INTERNATIONAL SOURCES OF FUNDING ECONOMIC DEVELOPMENT

Sandra Jednak*[1], Miloš Parežanin[1], Dragana Kragulj[1]
[1] Faculty of Organizational Sciences, University of Belgrade
*Corresponding author, e-mail: sjednak@fon.bg.ac.rs

Abstract: *In order to obtain economic growth and development, developing countries have implemented certain models, policies and funding. The aim of this paper is to analyse international sources of funding economic development of Serbia for the period 2005-2014. The structure and influence of international sources of funding (FDI, loans, aids, remittances) on the economic development of Serbia have been analysed. The results show that there is no statistically relevant influence of FDI on economic growth and development, that remittances have no influence on economic growth, but have certain positive effects on some components of economic development. Financial aids and loans have positive influence on economic growth and development in the short run. Apart of international sources of founding, there is a need for domestic sources for obtaining economic growth and development in the long-run period.*

Keywords*: economic development, international sources of funding, remittances, foreign direct investments, Serbia*

1. INTRODUCTION

Process of development in developed economies has been long-lasting and very complicated. These economies have obtained a high level of development in all fields: economic, political and social. On the other hand, most developing countries have not obtained such level of development. These countries are trying to find a way to obtain economic development more quickly and to decrease the gap in development between them and developed countries. Due to different levels of development of countries and complexity of economic development process, each economy should choose and implement suitable concept of development depending on their resources and possibilities.

There are different theories, models and policies of economic growth and development. Economic growth is considered to be a prerequisite for obtaining economic development. The two categories are mutually interrelated. In order to achieve a higher level of development, certain policies have to be implemented in order to obtain economic growth. The increase in national production, or economic growth, can be achieved by using resources more efficiently, or by increasing the resources, i.e. implementing new resources and technologies. Economic growth implies the growth in Gross Domestic Product, and thereby the growth of GDP per capita, which causes better standard of living. There are also some changes in allocation of the obtained income. Increased production, along with structural, institutional and other economic transformations brings to the economic development. That is why obtaining economic growth results in the increased level of economic development, which then results in the increased economic growth. Obtaining higher level of economic growth, the economic growth rate becomes more stable and lower. Developed countries have stable and low economic growth rates. Developing countries have the same aim. At the beginning of implementing economic reforms, developing countries achieve high rates of economic growth. Efficient use of resources and the foreign capital inflows lead to the increase in production which generates a higher level of income. Higher income enables higher saving, which is the basis for future investments that will influence economic growth and development. Obtaining economic growth and development in developing countries is related to choosing the appropriate model, policies and sources of funding. The aim of this paper is to analyse the influence of international sources on funding the development of Serbia for the period 2005-2014.

The paper includes following sections: Introduction is followed by Section 2 which provides an overview of economic growth and development theories. Section 3 provides an overview of sources of funding economic development. Section 4 is dedicated to the overview of economic development of Serbia, while Section 5 provides the analysis of structure and influence of international funding sources on economic development of Serbia. An overview of the achieved results is provided in the Conclusion.

2. THEORIES AND MODELS OF ECONOMIC GROWTH AND DEVELOPMENT

Economic development represents a progress in economy. Economic development is a slow, multidimensional and coherent process (Kragulj, 2014) directed towards the "improvement of living standard, greater availability and distribution of basic goods and services like food, shelter, health and protection, and expand range of social and economic choices available both individuals and nations (Todaro and Smith, 2009)".

After goals have been defined, there is a need for defining strategies and theories of economic growth and development. There are various strategies and theories of economic growth and development. Depending on the availability of certain resources, economic growth and development strategies can be based on: natural resources, labour or capital. Economic growth implies certain structural changes where the share of agriculture decreases in favour of industry and services sectors. Therefore, strategies can be based on the strategy of industrialisation or the strategy of agriculture. Furthermore, there are other criteria for defining strategies, according to which there can be strategies of balanced or imbalanced development, the strategy where state and market play dominant roles, the strategy of intensive and extensive development, opened or closed strategies, saving or consumer oriented strategies, etc.

If we consider the theories of growth and development, they can be divided into classical and contemporary theories. If we analyse only the growth theories, there are three basic groups of theories – classical, neoclassical and endogenous (Cypher and Dietz, 2009). Some growth theories, depending on the period of their application can be classified as a subgroup of certain theories of development. Each of the growth theories recognises certain economic factors that influence obtaining economic growth. Classical growth theory is related to natural resources and population. According to this theory the use of capital and labour increases income per capita, but population growth decreases it. Neoclassical growth theory explains that growth in gross domestic product per capita depends on technological changes that influence saving and investment, which further increase income per labour. If a country has a fast technology development, it will also have a high rate of economic growth, unlike the countries with the slower technology growth. Endogenous growth theory is based on innovation and knowledge. The theory is focused on human capital, which represents the entirety of knowledge, skills and competences of the employees in an economy, and which is the basis for increasing production.

According to Todaro and Smith (2009), classical models of growth and development are: 1) linear-stages theories, 2) structural-change models, 3) international-dependence revolution, and 4) neoclassical counter revolution: market fundamentalism. 1) Classical theories of growth and development recognize growth as the process of successive stages of economic growth. Each economy should undergo the successive stages in order to obtain economic growth through the mixture of saving, investments and foreign aid. Most frequently explained linear-stage theories are *Rostow's stage of growth* and *Harrod-Domar growth model*. The major limitations of these theories are that saving and investment are not a sufficient condition for obtaining economic growth. 2) One of the most popular *structural-change models* is Lewis Theory of development, i.e. the Lewis two-sector model. This theory focuses on structural transformation in underdeveloped economy. Economy consists of two sectors – traditional and modern sector. In the traditional agricultural sector there is surplus labour force that is transferred into the modern industry sector. Labour transfer and the increase in production and employment in the modern industry sector is the basis of this model and is determined by industrial investment rate and capital accumulation in the modern industry sector. *3) International-dependence revolution models* show that developing countries have dependence and dominance relationships because of institutional, political, and economic rigidities. These models see "developing countries as beset by institutional, political, and economic rigidities in both domestic and international setup" (Todaro and Smith, 2009). These models stress out the need for the policies that will decrease poverty, create new opportunities for employment and decrease income inequality. In developing countries, 4) *Neoclassical counter revolution: market fundamentalism* emphasises freer markets, dismantling of public ownership i.e. privatization of public enterprises and government regulation of economic activities. In addition to these activities, the model also recognizes other possibilities for obtaining economic growth like promoting free trade and export, drawing foreign investment and greater accumulation of capital as a consequence of decreasing influence of the state on the prices of goods and services and on financial markets.

Some of contemporary models of development are: 1) The Big Push and 2) Kremer`s O-Ring Theory of Economic Development. 1) *The Big Push theory* shows that market failures can be overcome by public policy. Furthermore, for development there is need for huge investment particularly in industry and infrastructure. 2) The basic idea behind *Kremer`s O-Ring theory* is that production requires a series of activities that should be done well in order to output obtains high value. Kremer`s O-Ring theory of economic development shows that development consists of a series of tasks, i.e. different economic processes that have to be interconnected. There have to be strong complementarities among economic processes. Beside

the mentioned classifications of theories, there is the classification of economic growth and development into – linear stages theories, balanced growth theory, theory of secular stagnation, the Gerschenkron effect and innovation growth theory.

3. SOURCES OF FUNDING ECONOMIC DEVELOPMENT

The role of the government in a developing country is to coordinate and make economic decisions in order to transform the economy and obtain higher level of development. Achieving economic growth and development depends on the source of funding. There are domestic and international (external) sources of funding. The basic sources of funding are – borrowing from IMF, the World Bank or other international organisations, various aids, domestic or foreign capital, especially foreign direct investments, and taxes.

Furthermore, sources of financing development could be divided into these categories: 1) accumulation and allocation of capital, 2) domestic saving and 3) external source of financing. 1) *Capital* could have different forms like: financial capital, capital goods, human capital, and natural resources. Regardless of the form of capital, the increase of capital and its efficient use remain the prerequisites for obtaining economic growth and development. Capital increase is through investments that are necessary for increasing production, productivity and growth. It is necessary for economy to properly allocate capital in order to achieve good economic performance and progress in the long run. 2) *Domestic savings* are the main source of financing investments at the level of individual economies. Savings represent a voluntary refraining from consumption in the present in order to achieve greater consumption in the future. If there would be no savings, but all the income would be placed into current consumption there would be no growth, but stagnation. Domestic savings depends on the amount of GDP per capita and the rate of national savings. Saving is a future investment that will lead towards economic growth and development. Within domestic saving, there is private and public saving. Private saving belongs to households and companies, while public saving can be positive or negative, depending on what is bigger – government revenues or expenditures. i.e. whether there is a budgetary surplus or deficit. Therefore, it can be concluded that savings finance investments, while budgetary revenues finance government expenditures.

External, i.e. international sources of financing are 1) foreign direct investments (FDI), 2) portfolio investment, 3) banks loans/ lending, 4) public international capital (Cvetanović, 2000; Dragutivnović et al., 2005), 5) foreign aids and 5) remittances. The inflow of foreign capital is determined by the return rate and/or risk. Capital inflows cause the increase in domestic savings, thus creating more funds available for investments and due to that, the rise in economic growth. High capital inflows increase total saving which brings to interest rate decrease and investment increase. It is necessary for developing countries to direct domestic investments that are financed by foreign funds in an adequate way. Otherwise, a debt crisis may appear if interest rates and dividends are not duly repaid to foreign investors. 1) Attracting *foreign direct investments* is one of the key issues for developing countries. The experience of some developing countries, especially transition countries, shows that FDI is an important driver of economic development. Campos and Kinoshita (2010) point out a strong connection between economic reforms (privatisation, financial and trade liberalisation) and FDI. FDI may have both positive and negative effects on economic performances. Positive effects of FDI are - generation of employment, raise of productivity, technology transfer, increased export and influence to obtain higher level of economic development (Parezanin et al., 2014). Due to that fact, developing countries try to improve many factors and policies that have influence on attracting foreign capital. Beside attraction of FDI, foreign portfolio investment has an important role in economic developing strategy. Portfolio investment is different from FDI. 2) *Portfolio investment* is composition of investment in shares, government and corporate bonds, treasury bills, different kinds of funds, deposits, etc. Composition depends on various factors, and one of the most important ones is risk. Portfolio investment diversification efficiently decreases risk, enables efficient allocation of resources and represents an important source of cash. Attracting foreign portfolio investment is connected to development of capital market in a way that if the market is well-developed, they can influence obtaining economic growth and development (Errunza, 2001). Most developing countries try to develop capital market to do market opening, regulation and liberalization. For example, Balkan stock market started trading in 1980 and continued until mid 1990s. The volume of circulation was quite small. Economic reforms (2000-2006) first affected financial sector. On average, stock prices on stock markets in Balkan countries increased over 70% in dollar terms (Kenourgios and Samitas, 2011). Market development causes foreign portfolio investments become more important source than debt, which is one of the major ways of funding in developing countries. Durham (2004) analysed the effects of FDI and foreign portfolio equity investment on growth and found that there is no direct effect on obtaining economic growth, but "the effects of FDI and foreign portfolio equity investment are contingent on the 'absorptive capacity' of host countries, with particular respect to financial or institutional development".
3) *Bank loans* are a form of lending where loans are provided by certain interest rates to a foreign country, institution or company. Such loans are usually granted by bank associations or a group of banks in order to

reduce risk. Bank loans provide more independence to the country or company that was granted the loan as for how the funds will be used. It is easier for a developed country to be granted a loan, because of a high level of political stability, lower risk, developed market and stable currency. 4) *Public international capital* is the most favourable source of capital inflows in developing countries. This form of financing refers to lending and borrowing between governments. Such capital flows are under direct government control. They are used to maintain credit stability, export and import financing or financing projects. 5) *Foreign aid* is international transfer of money, goods or technology in the form of aid that does not have to be given back, or as a transfer in the form of loan, where debt repayment terms (interest rates and repayment period) are much better than commercial terms. There are two basic types of foreign aid: a) public official bilateral and multilateral development assistance and b) private unofficial assistance provided by nongovernmental organizations. Donors, i.e. developed countries provide aid primarily due to political, economic or strategic interests, while donees, i.e. developing countries, receive aid for economic reasons. There are different views on effects of such aid. Some studies indicate that there are positive effects of foreign aid on structural changes and economic growth, while others show that there is no positive influence on obtaining economic growth through foreign aid. Edwards (2014) analysed the effectiveness of foreign aid. He claims that foreign aid tends to create dependency, fosters corruption and encourages currency overvaluation, but on the other hand foreign assistance should be increased in order to reduce poverty. OECD provided a term Official development assistance (ODA) that measures aid. Official development assistance (ODA) "is defined as government aid designed to promote the economic development and welfare of developing countries". ODA includes concessional loans and grants. ODA loans and grants are providing low-interest, long–term and concessional funds to finance the development in developing countries. ODA loans require repayment, and supervision of the projects financed by ODA, thus promoting the efficient use of the granted loans. 6) *Remittances* are increasingly important for poverty reduction, obtaining economic growth and development due to migrations. Remittances are associated with monetary gains and human development in the areas such as health, education and gender equality. Remittances that are transferred in developing countries are almost three times greater than official development assistance. It is estimated that in 2014 developing countries' remittances amounted to $ 427 billion. Remittances are greater in smaller and low-income countries (The World Bank, 2014). Remittance increase gains more and more importance in the international capital flows, especially in the countries with lots of migrations.

4. SERBIAN GROWTH AND DEVELOPMENT MODELS

Economic growth and development in Serbia rests on domestic demand, import and need for foreign funds. In the period 2001-2008 the economic growth average was 4.9% annually (Izvestaj o razvoju Srbije, 2010). When "Europe 2020" strategy was adopted, Serbia established a new economic growth model for Serbia 2020. The new model of economic growth changed from consumer-oriented to pro-investment and export-oriented. The growth of this new strategy is based on the reform of the public sector, economic restructuring (reindustrialization, development of agriculture, telecommunications and information society development) and infrastructure development. The main aims are – increase in employment, human capital improvement, investing in knowledge and technology, export-based growth, efficiency in energy use and poverty reduction. However, accomplishing such objectives depends on – fixed investment increase, reducing the share of public consumption in GDP, increasing the share of export in GDP and decreasing deficit of the current account (Jednak et al.,2014).

Since the end of the global crisis, Serbia has run tight fiscal policy in order to obtain economic recovery. Economic growth is mostly driven by investments. The greatest investments were in automobile and oil industry. Those two industries had a big impact on export and growth. It was projected that economic growth for 2015 would be about 0.5 % (the World Bank), and in 2016 the plan was to reach 1.8 %. According to National Bank of Serbia (2015), economic growth could be obtained by "monetary policy relaxation, business climate improvement, structural reforms and external demand recovery". Economic growth was also the result of new investment loans that pushed up private investments. Investment loans were 2.5 times higher in 2015 than in 2014. Besides, investment loans increased FDI inflows. In 2015 FDI inflows were 45.6 % higher than in 2014. Attraction of FDI was the consequence of implementation of structural reforms and better business and investment climate. External imbalance was reduced due to export increase. Internal imbalance was improved because of reduction of pensions and wages on one hand, and better collection of revenues, on the other hand. Lower interest rate should lead to recovery in lending activities i.e. rise in demand for loans. During the time, similarly to all the other countries, economic growth and development In Serbia was financed by the government, banking sector, financial markets and investors. External sources of financing, especially economic FDI and loans are considered to be crucial sources of Serbian economic growth and development. However, remittances are more and more important.

5. STRUCTURE AND INFLUENCE OF INTERNATIONAL FUNDING SOURCES ON DEVELOPMENT IN SERBIA

International sources of funding, such as FDI, remittances and official development assistance (ODA) have been significantly increased during the past few years, and more attention has been paid on their influence on economic development (Driffield and Jones, 2013). International financial institutions are of particular importance for financing economic development in developing countries (Dreher and Gassebner, 2012; Kanbur and Sumner, 2012; Greenhill et al, 2013).

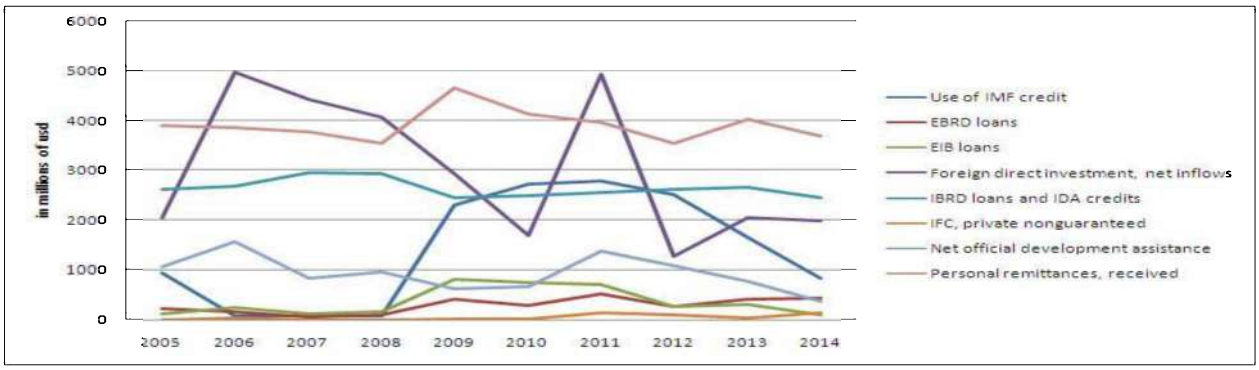


Figure 1: International sources of funding in Serbia (2005-2014)

Figure 1 represents the structure of international sources of funding in Serbia for the period 2005-2014 (European Investment Bank, 2016; European Investment Bank, 2016; the World Bank, 2016). The inflows of the IBRD and IDA loans are relatively constant. IMF borrowing started to increase at the beginning of the 2008 crisis, but since 2012 loan amounts have been decreasing. The loans inflows granted by other international financial institutions and from Official development assistance (ODA) is significantly lower. Such form of financing demands additional costs such as loans and losses due to changes in foreign exchange rates (Seiber, 2013).

It can be noted that FDI and remittances dominate throughout the observed period. However, the inflow is not constant. Remittance inflows peaked in 2009, but afterwards they decreased each year to reach their lowest level in 2012. Remittance inflows slightly increased in 2013. FDI showed significant fluctuations throughout the entire observed period. The greatest inflows were recorded in 2006 and 2011, and the lowest income was recorded in 2010 and 2012. In the periods 2008-2010 and 2012-2014 the remittance inflows surpassed the FDI inflows.

Remittances cause two kinds of effects. If they are capital-oriented, then along with FDI and foreign aid they can be significant for the long-term economic development. However, if remittance inflows are primarily used by households to alleviate short-term financial problems to finance consumption, then remittances do not influence economic development, but significantly increase living standard of the citizens in that country. There are certain cases though, when due to the increase in consumption, remittance inflows can influence long-term economic growth, even if they are used by households (Morton et al., 2010).

5.1. The Influence of Foreign Direct Investments and Remittances on Economic Development

Since FDI and remittances dominate in the structure of international funding of economic development in Serbia, it is necessary to determine whether there is a correlation between the mentioned sources of funding and economic development of Serbia. The following variables are used as the indicators of economic development: GDP per capita, unemployment rate, population (the World Bank, 2016) and HDI (United Nations Development Programme, 2016).

In the observed period (2005-2014) there was no statistically relevant correlation between FDI and economic development. Similarly, there was no statistically significant correlation between remittances and economic growth indicators (Table 1).

Table 1: Correlation between FDI net inflow / Personal remittances and GDP per capita, unemployment rate, population and HDI (2005-2014)

		GDP per capita	Unemployment rate	Population, total	HDI
Foreign direct investment, net inflows	Pearson Correlation	0.039	-0.306	0.447	0.222
	Sig. (2-tailed)	0.916	0.39	0.195	0.538
	N	10	10	10	10
Personal remittances, received	Pearson Correlation	-0.061	-0.172	0.097	-0.209
	Sig. (2-tailed)	0.868	0.634	0.789	0.561
	N	10	10	10	10

In order to discern whether these are the consequences of the global economic crisis or a long-term trend which indicates that there is no statistically significant correlation between FDI and remittances, and economic development in Serbia, the observed period was separated into two sub-periods - period 2005-2008 and the period after the economic crisis 2009-2014. The influence of the global economic crisis on the correlation between FDI and economic development is evident in almost all countries of Southeast Europe (Kragulj and Pareţanin, 2015).

Table 2: Correlation between FDI net inflow / Personal remittances and GDP per capita, unemployment rate, population and HDI (2005-2008)

		GDP per capita	Unemployment rate	Population, total	HDI
Foreign direct investment net inflows	Pearson Correlation	0.424	-0.215	-0.544	-0.004
	Sig. (2-tailed)	0.576	0.785	0.456	0.996
	N	4	4	4	4
Personal remittances, received	Pearson Correlation	-0.972*	0.993**	0.950*	0.885*
	Sig. (2-tailed)	0.028	0.007	0.05	0.115
	N	4	4	4	4

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

In the first observed period there is no statistically significant correlation between FDI and the chosen indicators of economic growth. However, there is a significant and strong correlation between remittances and economic growth indicators (Table 2). A significant positive correlation exists between remittances on one hand, and unemployment rate, population and HDI on the other. Strong negative correlation exists between remittances and GDP per capita, which means that remittances and economic growth are almost perfectly negatively correlated. Such observations are in accordance to the research (Barajas et al., 2009; Aggarwal, et al, 2011; Bettin and Zazzaro, 2012) that discuss negative correlation between remittances and GDP per capita in certain developing countries.

Table 3: Correlations between FDI net inflow/Personal remittances and GDP per capita, unemployment rate, population and HDI (2009-2014)

		GDP per capita	Unemployment rate	Population, total	HDI
Foreign direct investment, net inflows	Pearson Correlation	0.604	-0.011	0.238	-0.213
	Sig. (2-tailed)	0.204	0.984	0.649	0.686
	N	6	6	6	6
Personal remittances, received	Pearson Correlation	-0.111	-0.914*	0.771	-0.816*
	Sig. (2-tailed)	0.834	0.011	0.073	0.048
	N	6	6	6	6

*. Correlation is significant at the 0.05 level (2-tailed).

Throughout the observed period 2009-2014 no significant correlation between FDI and economic development was recorded. There was, however, a significant negative correlation between remittances and unemployment rate, and remittances and HDI. Throughout this period there was a decrease in remittance inflows into the Republic of Serbia, but there was also an increase in unemployment rate as compared to the previous period.

6. CONCULISION

Slow economic growth and drop in domestic demand caused stagnation in economic development and demand for additional capital. External sources of funding are significant for economic development of Serbia. At the beginning of economic reforms implementation, capital inflow contributed to economic growth and development. In the period 2005-2014, FDI showed downward tendency, except in 2006 and 2011 when the highest inflow was recorded. Low FDI inflows resulted in the fact that in the period 2005-2014 they had no influence on economic growth, and consequently on economic development. Constant remittance inflows are used for final consumption, therefore increasing purchasing power of the population. There was a significant influence of remittances on certain components of economic development, but there was also a negative correlation to economic development in the period 2005-2008. Therefore, we cannot talk about positive influence of remittances on economic development.

Financial lending (loans, grants and credits) and, aids and assistances provided by international financial institutions can influence financial development of Serbia, but only in the short run. However, if this way of funding continues to exist in the long run, it can cause a significant outflow in the form of debt repayment and losses caused by variation in exchange rate. Another issue arises when such approved funds are used for financing current government expenditures. Many credits were granted by international financial institutions to build infrastructure objects. Nonetheless, few infrastructure objects have been realised so far, and Serbia is still among the countries with underdeveloped infrastructure.

Implementation of the new economic growth model in Serbia has yielded some results. It is clear that long-term growth of Serbia should rest on clear development policies. FDI should be a dominant source of international funding and it should be primarily export-oriented. Although some important incentives have been provided to encourage foreign investments, underdeveloped infrastructure and low purchasing power of population make Serbia a less attractive investment destination, which currently prevents it from achieving a more significant level of economic development through external sources. Economic development should be funded from foreign sources, but domestic sources should be used as well.

REFERENCES

Aggarwal, R., Demirgüç-Kunt, A., & Pería, M. S. M. (2011). Do remittances promote financial development?. *Journal of Development Economics*, 96(2), 255-264. doi:10.1016/j.jdeveco.2010.10.005

Barajas, A., Chami, R., Fullenkamp, C., Gapen, M., & Montiel, P. J. (2009). Do workers' remittances promote economic growth?. *IMF Working Papers*, 1-22.

Bettin, G., & Zazzaro, A. (2012). Remittances and financial development: substitutes or complements in economic growth?. *Bulletin of Economic Research*, 64(4), 509-536. doi: 10.1111/j.1467-8586.2011.00398.x

Campos, N. & Kinoshita, Y. (2010). Structural Reforms, Financial Liberalization, and Foreign Direct Investment. IMF Staff Papers, 57, 326-365. doi:10.1057/imfsp.2009.17

Cvetanović, S. (2000). *Finansiranje privrednog razvoja*. Ekonomski fakultet. Nis.

Cypher M.J., & Dietz L.J, "*The Process of Economic Development*", 3th Edition, Routledge, 2009.

Dragutinović, D., Filipović, M., & Cvetanovic, S. (2005). *Teorije priverdnog rasta i razvoja*. Ekonomski fakultet, Beograd.

Dreher, A., & Gassebner, M. (2012). Do IMF and World Bank programs induce government crises? An empirical analysis. *International Organization*, 66(02), 329-358. doi: http://dx.doi.org/10.1017/S0020818312000094

Driffield, N., & Jones, C. (2013). Impact of FDI, ODA and migrant remittances on economic growth in developing countries: A systems approach. *European Journal of Development Research*, 25(2), 173-196. doi:10.1057/ejdr.2013.1

Durham, J. (2004). Absorptive capacity and the effects of foreign direct investment and equity foreign portfolio investment on economic growth. European Economic Review. 48(2), 285-306. doi:10.1016/S0014-2921(02)00264-7

Edwards, S. (2014). Economic development and the effectiveness of foreign aid: A historical perspective. Working Paper 20685, NBER Retrieved from

Errunza, V. (2001). Foreign portfolio equity investments, financial liberalization, and Economic Development. Review of international Economics, 9(4), 703-726.

European Bank for Reconstruction and Development (2016). The EBRD in Serbia. Retrieved from http://www.ebrd.com/serbia.html

European Investment Bank (2016). Serbia - European Investment Bank. Retrieved from http://www.eib.org/projects/loans/regions/enlargement/rs.htm

Greenhill, R., Prizzon, A., & Rogerson, A. (2013). The age of choice: developing countries in the new aid landscape. *Synthesis Report*. Londres: ODI.

Izveštaj o razvoju Srbije 2010. (2010). Ministarstvo finansija i privrede.

Jednak S., Makajic Nikolic D., Kragulj D., & Vujosevic M., (2014). Economic Activities Structure and Development: Evidence From Serbia, Management, No. 71, 29-38. DOI: 10.7595/management.fon.2014.0012

Kanbur, R., & Sumner, A. (2012). Poor countries or poor people? Development assistance and the new geography of global poverty. *Journal of International Development*, 24(6), 686-695. doi: 10.1002/jid.2861

Kenourgios, D., & Samitas, A. (2011). Equity market integration in emerging Balkan markets. Research in International Business and Finance, 25, 296-307. doi:10.1016/j.ribaf.2011.02.004

Kragulj, D., & Parezanin, M. (2015). Foreign Direct Investment and Economic Growth in Times of Economic Crisis: Evidence from Southeast European Countries. European Scientific Journal, ESJ,11(10), 221-231.

Kragulj. D. (2014). Ekonomija: osnovi mikroekonomske i makroekonomske analize

Morton, J., Panday, P., & Kula, M. (2010). Remittances, Poverty and Economic Growth. *International Journal of Arts and Sciences*, 3(7), 390-399.

Parezanin, M., Jednak, S., & Kragulj, D. (2014). Foreign direct investments and economic growth: the case of Serbia, SYMORG 2014, Zlatibor, Symposium proceedings "New business models and sustainable competitiveness", Faculty of Organizational Sciences

Seiber, M. J. (2013). *International Borrowing by Developing Countries.* Pergamon Policy Studies on International Development: Elsevier.

The National Bank of Serbia. (2016). Macroeconomic developments in Serbia.

The World Bank (2016). World Bank Indicators. Retrieved from http://data.worldbank.org/

The World Bank. (2014). Migration and remittances.

Todaro, M.P., & Smith,S.C. (2009). *Economic Development.* 10th Edition. Pearson Education.

United Nations Development Programme (2016). Human Development Index (HDI). Retrieved from http://hdr.undp.org/en/content/human-development-index-hdi

TRANSFER PRICES - AN INSTRUMENT FOR BOOSTING COMPETITIVENES OF MULTINATIONAL ENTERPRISES

Snežana Popovčić-Avrić*[1], Marina Šestović[1], Tamara Todić[2]
[1]Faculty of economics, finance and administration
[2]Tandem Pro company
*Corresponding author, e-mail: msestovic@fefa.edu.rs

Abstract: *In the era of globalisation and growing interdependence of the world economy, multinational enterprises are achieving competitiveness in the global markets due to their widespread and efficient distribution network and intra-firm transactions. Transfer prices are a tool that enables multinational enterprises to influence their level of profit in certain markets. Furthermore, they are able to redistribute the profit at the desired destination, thereby affecting their competitiveness, tax savings, operating results and volume of trade. Their intra-firm transactions cause an outflow of taxable income from one country to another. The paper will analyse the impact transfer prices have on boosting the competitiveness of MNEs and on redefining their business strategies against the backdrop of harmonisation of tax regulations.*

Keywords*: multinational enterprises, transfer pricing, competitiveness*

1. INTRODUCTION

The growing impact of globalisation has helped strengthen the position of multinational enterprises (MNEs) in the global markets. MNE expansion on the global level can be analysed from several economic aspects. Their biggest influence is reflected in the transfer of technology to developing countries and transition economies. Together with their growing trade volumes, this has lead to an increase in Foreign Direct Investment (FDI) inflow and to rising gross domestic product (GDP). MNEs are driven to expand into the new markets mainly by their desire to increase their market share and profits, receive a preferential tax treatment, and to compensate for the saturation of their home and existing markets.

MNE expansion into new markets and opening of new branches worldwide requires significant initial investments, and research of the market and local regulations. Many MNEs face serious legal barriers to establishment and entry of foreign capital. One such barrier is taxation of MNE's profits gained abroad. It is a well known fact that MNEs build their competitiveness in the global markets on the economies of scale and efficient production processes which depend on relocation of their production into labour-intensive countries. MNE's business processes are engineered to create savings by having transactions with associated enterprises within the regional or global group. Intra-firm trade within MNEs between their affiliates is based on pre-arranged preferential prices, better known as transfer prices. It makes sense for MNEs to apply transfer prices for transactions within group members, because this strengthens the competitiveness of the entire MNE. All MNEs defend this business model by citing business policies included in their articles of incorporation.

Many MNEs have recognised transfer prices as a tool that guides trade flows and relocation of capital to more attractive tax destinations. As transfer prices can influence net operating profit of an MNE in a given country, tax authorities in those countries have identified this channel of capital outflow as problematic and suspicious. To harmonise tax regulations in this area, Organisation for Economic Cooperation and Development (OECD) has provided a set of rules for testing and recognising these transactions, which both MNEs and tax authorities are required to adopt. While MNEs are striving to avoid double taxation of their global operations, it is in the interest of the local tax authorities to keep as much of the profit tax as possible in their own country.

Transfer prices are becoming an ever-growing challenge for both tax authorities trying to harmonise new regulations and for multinational enterprises whose main competitiveness tool is being scrutinised by the lawmakers. Harmonisation of international and local regulations does exist to a certain level, but is incomplete. The effects of differences between local regulations and OECD guidelines can significantly affect the changes in MNEs' business strategies. Due to application of rules on transfer pricing, MNEs may decide to relocate their business to a country where they enjoy better privileges and higher tax reliefs. Furthermore, MNEs are prompted to potentially manipulate transactions in order to optimise their expense and revenue levels in any case.

2. IMPROVING THE COMPETITIVE POSITION OF MNEs

Understanding the structure and the operational particularities of an MNE established as a corporate network of affiliates points to the main factors of profitability of multinational enterprises, (Cole-Ingait, 2015):

- *Price efficiency* in the production process and creation of the value chain, which ensures a competitive selling price. By integrating kindred production or marketing activities in one location, a lot of cost savings is achieved through economies of scale, and all this is achieved via transfer pricing.
- *Operational efficiency*, which entails integrated production processes, use of information technologies and strategic platforms to maximally cut wastage, production time and costs by applying transfer pricing.
- *Pricing strategy* involves an individual and proactive approach to price formation on a specific local market. Since it is impossible to unify the global market, in order to optimise sales volumes, MNEs resort to creating market-specific strategies. Their goal is to acknowledge the specific market conditions and adapt the products to those conditions, in order to optimise sales and profits.
- *International marketing strategy* whose objective is to overcome the cultural and local barriers when placing products or sending public messages of the multinational enterprise, thus creating a positive image of its brand across the markets. This approach provides also for global positioning and international brand recognition.
- *Production and distribution flexibility* allows multinational enterprises to satisfy customer preferences and maintain brand loyalty.

Local market imperfections help strengthen the competitive position of MNEs by allowing them (Wittendorf, 2010):

- to achieve economies of scale,
- through the process internationalisation, to manipulate the prices and tax burden on the local markets,
- through horizontal and vertical integration, to create competitive advantage for themselves and their consolidated enterprises,
- through vertical value chain integration, to reduce transaction costs,
- to use their bargaining power and price differentiation to create market entry barriers for new competitors.

It can be concluded that MNEs' competitive advantage is based on the economies of scale in production, financial channels available to them, research and development (R&D), as well as on the process of gathering market intelligence. MNEs are also in a much better position compared to local enterprises with regards to controlling their operating conditions, i.e. the ability to choose their business environment. For instance, when deciding on the location where they will manufacture their components, MNEs first carefully select countries with low wages that also offer the best incentives in the form of tax reliefs, subsidies and foreign trade benefits. The very size of MNEs relative to the economies they go into demonstrates how favourable their position is to influence the local authorities and benefit from that, compared to any other local company. Furthermore, MNEs can acquire any prosperous local firm and thus prevent having any future competition, just as it can apply other methods to limit exchange and increase their profit. Through greater diversification, MNEs manage to reduce the risk and usually earn a higher profit relative to local firms.

3. TRANSFER PRICES – ROLE AND IMPORTANCE

3.1. Transfer price definition

Transfer price (TP) is a price, i.e. the amount a company charges for goods, services and intangibles sold to a subsidiary or another associated company or natural person (Ljutić, 2014). When the transfer price deviates from the market price range at which independent entities trade, the profit gained by the buyer and seller is redistributed within the MNE. For example, when the transfer price of the seller is overpriced, the buyer's profit is reduced, while the seller's profit increases. The buyer reports higher expenses and lower profit, unlike the seller, who reports higher revenue and a higher profit. Though the profit has been dislocated at the local level, the consolidated profit at the level of the entire MNE group remains unchanged.

The previous example suggests that the transfer pricing policy for consolidated entities (within an MNE) is very important for achieving their financial goals. If these entities are highly decentralised, transfer prices are very important because they directly influence revenues and expenses, i.e. the distribution of the overall consolidated profit, as well as the transfer of profit between the consolidated entities.

When a group of associated persons operates at a national level, all group members operate within one country and under the same tax and market conditions. Application of transfer prices regulations has no tax

implications in this case, because the taxable income at the state level is the same, and the profit is transferred between associated persons, without affecting their consolidated profit.

When a group of associated persons operates on the international level, all group members operate under different tax and market conditions, and the profit is transferred via transfer pricing most frequently with the objective of reducing the tax liability (toward a jurisdiction with the lowest tax burden). This does not affect the consolidated profit within an MNE, but it does affect the level of tax burden for the individual MNE branch and tax revenues of countries in which each group member operates.

To prevent this allocation of the profit, and of the capital, tax authorities in most countries legislate how transfer prices are to be tested in order to establish whether the transfer price is close to the market range. This test entails that a transfer price transaction is to be compared with a similar arm's length transaction, i.e. a transaction between non-related entities:

- Internally, where MNE uses its own transaction with another, independent entity,
- Externally, where MNE uses the transaction of two other independent entities.

3.2. Controlled transactions

Controlled or intra-firm transactions are a common feature of modern operation and are generally manifested through transactions between associated entities. The main characteristic of controlled transactions is the absence of conflict of interest and the fact that they are made at transfer prices, which are pre-arranged and unaffected by external market factors. These intra-firm transactions can be of commercial (trade) or financial nature and they most frequently include:

- Selling or buying goods or production materials,
- Selling or buying property,
- Property rental,
- Delivery of services (IT services, management fees, marketing services, financial and consulting services, etc.)
- Transfer of intangible property (for instance research and development, trademark, licensing agreements),
- Guarantee, receipt or provision of financial services (loans and deposits),
- Joint investments etc.

Given that MNEs operate in jurisdictions with various tax rates and tax rules, the different transaction structures and intra-firm pricing policies may significantly influence the global tax burden of the entire MNE. Even in cases where there are no variations in tax rates, the possibility of double taxation still exists and poses a threat to an MNE's financial position. As transfer prices on their own require that a certain level of profit be made by both parties to the transaction, they play an important role in the decision making process of the parent company's general management with regard to assessing the potential profit of the business unit for the purpose of capital allocation. Apart from the general management, transfer prices are also of key importance for (Bronson, et.al 2013):

- *The MNE's tax department*, which is the one most affected by transfer prices. The tax department must be familiar with tax systems in different jurisdictions and reconcile them into a single transfer pricing policy in line with legal norms. Also, in exceptional circumstances, these departments are expected to prepare additional reports for tax authorities regarding their intra-firm transactions.
- *Financial department*, because the effect of the transfer pricing policy is reflected on the stated profit and on the tax on profit reported in financial statements. Whether an MNE is located in a territorial tax system where foreign income is taxed locally or not, transfer prices affect the general taxation of an MNE.
- *Company operations*, where the transfer pricing policy must meet the legal requirements of the environment. For an MNE not to jeopardise its tax burden, the MNE's tax department stipulates transfer prices that are within the market range and are thereby defendable before the tax laws of that country.
- *MNE's accounting department* is very important, because it confirms that the established transfer pricing policies have been properly implemented and ensures that the reporting system provides real information on transactions with associated entities, and in the required form for the purpose of transfer pricing analysis.
- *MNE's legal department,* because intra-firm transactions take place in accordance with intra-firm policies and agreements, which are generally regulated by the legal department.
- *Tax authorities* are mostly interested in the transfer pricing policy, because these prices directly affect the level of public revenue.
- *Independent auditors*, whose duty is to establish whether a company concerned has properly determined its profit tax. A part of that analysis definitely involves transactions with associated entities and transfer prices, because these are of material significance for operating profit.

- *External and tax advisors*, as many global and local consulting companies worldwide specialise in transfer pricing.

4. APPLICATION OF TRANSFER PRICING POLICIES IN INTERNATIONAL OPERATIONS

4.1. OECD guidelines

Taking into consideration the growing importance of transfer prices in MNE operations and their potential impact on tax systems, in July 1995, OECD Council approved the publication of *OECD Transfer Pricing Guidelines for Multinational Enterprises and Tax Administrations* (the Guidelines), compiled by the Committee on Fiscal Affairs (the Committee). The Guidelines are the key global regulation regarding the application of transfer pricing rules and tend to be periodically adjusted and updated to reflect the experience of the member states and the wider business community in application of these principles and methods. The Committee in conjunction with the OECD Council monitors the application of these regulations in most countries and takes care of their implementation and consistency. In essence, the Committee's monitoring role is to test the laws and practice of the member states against the Guidelines, to identify the areas of the Guidelines that could be improved and amended, and to notify the OECD Council accordingly.

One of the main principles contained in the OECD Guidelines is the arm's length principle, which represents an international standard established by the OECD member states for applying rules on transfer pricing for tax purposes. The arm's length principle follows the approach where MNE group members are treated as two enterprises operating independently, their agreed conditions are set aside, and market conditions valid for similar transactions are applied. When the separate entities approach is applied to MNE, and associated persons are treated as independent, the focus is placed on the nature of the transaction and whether it is different from a comparable non-controlled transaction. This approach is called a comparability analysis, which is in the centre of the arm's length principle.

The basis for comparability analysis is the comparing of conditions under which controlled and uncontrolled transactions are conducted and determination of profit when arm's length principle is applied. The first important assumption when comparing a market transactions and an arm's length transaction is that when assessing the conditions of a potential transaction, independent entities will take into consideration also other real options available on the market and will accept a given transaction only if they fail to find a more favourable alternative. This principle should also be applied by tax authorities when testing transfer prices. When testing comparability factors, it is vital to take into consideration real-world transactions realised between two independent entities.

When assessing the market reality of transfer prices, OECD Guidelines accept the following methods for testing:

I Traditional transactional methods:

1) Comparable uncontrolled price;
2) Resale price method;
3) Cost plus method;

II Transactional net-profit methods:

4) Transactional net margin method;
5) Transactional profit split method;

The objective of choosing one or a combination of these methods is to make it appropriate for the specific situation. Accordingly, one should bear in mind the advantages and flaws of the offered methods, their adequacy established through functional analysis, availability of data for their application, level of comparability between a controlled and uncontrolled transaction. No method is reliable in every potential situation, hence their applicability in a given test transaction needs to be proven.

4.2. Application of rules on transfer pricing in countries with preferential tax systems and rapid-growth markets

Repositioning a part of MNEs operation into jurisdictions with preferential tax regimes (JPTR) and rapid-growth markets, besides strengthening the competitive position and global risk diversification, is frequently motivated by financial and tax savings. From the viewpoint of transfer pricing policy and intra-firm trade between MNEs and their branches in those regions, various issues in applying the arm's length principle may arise. The key problem with rapid-growth markets and developing countries regarding transfer pricing

regulations is the absence of or lack of harmonisation of tax laws. This may lead to difficulties in applying the regulations in practice and eventually result in administrative costs for both the MNEs and tax authorities. In many developing countries the notion of determining transfer prices is still novel, and in some developing countries there is still no legal requirement to set those prices. The challenges the developing countries face when striving to implement OECD Guidelines in their regulations involve: absence of comparable entities and/or transactions in the market, insufficiently developed knowledge and skills in the area of transfer pricing, complexity of application due to absence of adequate administrative basis, growing importance of information technologies and new business models. This can create further problems for consolidated entities within MNEs with head offices located in developed countries having transaction with associated entities in developing countries.

The difficulties in applying the arm's length principle in jptrs and rapid-growth markets may be assuaged by establishing rules on tax havens for the mnes to follow, which would make transfer prices acceptable for tax authorities as well. A tax haven relieves a specific category of companies from paying some duties in exchange for fulfilment of other, simpler obligations. From the aspect of transfer pricing, requirements of a tax haven may range from a complete tax relief for a given group of taxpayers to the obligation for these companies to comply with national transfer pricing laws and different procedural rules in order to be allowed into the tax haven.

5. CONCLUSION

MNEs competitive position in the global business environment is primarily reflected in the sprawling network of MNE branches on the global market and their intra-firm trade. On top of providing for economies of scale, production efficiencies, specialisation, technology development and transfer, MNE influence the overall dynamics of global trade and shape the international business environment via intra-firm trade. Intra-firm trade at transfer prices has become a hallmark of globalisation, because it creates a powerful position for MNEs in the global and local markets. This power is primarily reflected in their ability to choose locations where they will operate and to use their dominance to influence local authorities to create a more favourable business environment. Their power is also reflected in their ability to use transfer pricing to diversify losses and tax burden, and consequently to increase their profit.

Because of these global implications, transfer prices have been in the focus of interest of international organisations, local tax authorities, MNEs and other stakeholders. Implementation of international regulations and OECD Guidelines in laws of the countries in question should limit the impact MNEs exercise via transfer prices. On the other hand, application of the rules on transfer pricing will persuade the MNEs to thoroughly plan the transfer prices they apply in intra-firm transactions, review their intra-firm agreements, and also to seek other mechanisms to optimise their consolidated profit.

ACKNOWLEDGE

This Research Paper was a part of the Project "Advancing Serbia's Competitiveness in the Process of EU Accession", no. 47028, in the period 2001-2015, financed by the Serbian Ministry of Science and Education.

REFERENCES

Bakker, A., & Levey, M. (2012). Transfer Pricing and Intra-Group Financing. Amsterdam, IBFD

Behrens, K. et al (2007). Transfer Pricing Rules, OECD Guidelines and Market Distortions, Working Paper No 06/2007, Indiana University

Bronson, M. et al (2013). Guide to International Transfer Pricing, Kluwer Law International

Feinschreiber, R., & Kent, M.(2012). Transfer Pricing Handbook – Guidance for the OECD Regulation. New Jersey, John Wiley & Sons Inc.

Heimert, M.(2013). Guide To International Transfer Pricing. Alphen aan den Rijn, Kluwer Law International

Huizinga,H., & Laeven,L.(2008):International profit shifting within multinationals: A multi-country perspective, Journal of Public Economics, 92 (5-6),1164-1182.

Ingait-Cole, P. (2015). Factors That Affect a Multinational Corporation Available on: http://smallbusiness.chron.com/factors-affect-multinational-corporation-75252.html

Ingait-Cole, P. (2015). How to Maximize Your Profit in a Multinational Corporation Available on: http://smallbusiness.chron.com/maximize-profit-multinational-corporation-75935.html

Jost, S. (2009). Transfer Pricing Risk Awareness of Multinational Corporations: Evidence from a Global Survey. Working paper 2009-06, University of Salzburg

Kostić, S. (2014). "Metode transfernih cena", in: Studije za inovaciju iz oblasti transfernih cena held at Pravni Fakultet Univerziteta u Beogradu

Kostić, S. (2014). “Odredbe o transfernim cenama i usluge koje se pružaju među povezanim licima”, in: Studije za inovaciju iz oblasti transfernih cena held at Pravni Fakultet Univerziteta u Beogradu
Levey, M. et al (2006). Transfer Pricing Rules and Compliance Handbook. Chicago, Wolters Kluwers Business
OECD (2010). Transfer Pricing Guidelines for Multinational Enterproses and Tax Administrations. Paris, OECD PUBLISHING
Schön, W., & Konrad, K. (2012). Fundamentals of International Transfer Pricing in Law and Economics. Berlin, Springer-Verlag
Wittendorf, J. (2010). Transfer Pricing and Arm’s Length Principle in International Tax Law. Alphen aan den Rijn, Kluwer Law International

ROMANIA AND SERBIA – SIMILARITIES AND MAJOR DEVIATIONS FROM THE STATISTICAL PROFILE OF A GENERIC BALKAN ECONOMY

Gheorghe Săvoiu[1], Marian Taicu[1],Mladen Čudanov[2*]
[1] University of Pitesti, [2] University of Belgrade, Faculty of Organizational Sciences
*Corresponding author, e-mail: mladenc@fon.bg.ac.rs

Abstract. *This paper uses the statistical method of profiling in order to detach a few defining aspects of Balkan economies of Romania and Serbia in the context of the peninsula where they belong geographically, and by confronting economic and social performance. The article presents several profiles, in a methodical and structured manner, in an attempt to identify significant similarities and deviations from a generic profile of the Balkan country or economy of the two economic entities and neighbours, one of which has already been a EU member since 1 January 2007, and placed within an intense and converging process of integration, and the second one located at the end of a long process of accession to the same European Union. A special case between the profiles analyzed is that of the energy dependence of GDP and that of flows of exports and imports at a macroeconomic level depending on fuel prices in both Romania and Serbia, which is actually the very illustration of the complexity of the econometric profile as part of the method of the statistical profile in general.*

Keywords: *profile method, Balkan economies and countries, the Balkan Peninsula, economic gap, statistical confrontation*

1. INTRODUCTION

The Balkan area is not homogeneously defined in the literature, and the media themselves provide delimitations based rather on the geographical criterion, as well as demarcations primarily based on political, cultural and historical criteria. The etymology of the peninsula's name is linked to the Turkish word "balkan", which means "wooded mountain" (Griffiths, Krystufek and Reed, 2004). All these issues have induced the idea of a Balkan economy or profile, with special emphasis on studying Romania and Serbia, as targets declared in the very title of this paper. From a geographical standpoint, the Balkan Peninsula can be defined in two distinct ways: by convention, and considering the strict definition of a peninsula. By convention, it is generally considered that the peninsula is bounded, on the north, by the waterways Soca-Vipava-Krka-Sava-Danube. Given the geographical notion, as the easternmost of the three major peninsulas in southern Europe, the Balkans encompass the entire territory between the Black Sea and the Adriatic Sea (including parts of Hungary, the Republic of Moldova and the Ukraine).

From a political point of view, the term Balkans is sometimes used to refer to a limited group made up of several countries (http://www.state.gov/p/eur/rt/balkans/). Thus, the acceptation given by the US State Department, includes the Balkan states of former Yugoslavia (except Slovenia) and Albania. Also for political purposes, the European Union institutions use the term "Western Balkans" to refer to the Balkan states that are not members of the European Union (http://ec.europa.eu/trade/policy/ countries-and-regions/regions/western-balkans/). Starting from the geographical criterion, and also from political and historical criteria, it can be considered that the Balkan Peninsula (or the Balkans) includes Albania, Bosnia & Herzegovina, Bulgaria, Croatia, Greece, Macedonia, Montenegro, Romania, Serbia, Slovenia and Turkey's European region. The Balkan states have a common history: their territories were included, in turn, in the Roman Empire, the Byzantine Empire, and later the Ottoman Empire. The Balkan Peninsula is the European region which had the most volatile borders: in the last hundred years alone they changed several times. Given that Turkey is located mostly in Asia, and also the fact that in point of area and population, it exceeds all the other Balkan states, we chose not to include Turkey in the analysis or the specific profile of a Balkan country.

If one takes into account the population and the size of the Balkan countries, they are generally small in both geographical and demographic terms. As far as the area of the Balkan states, it appears that most of them have less than 100,000 km^2. Romania is the only state with an area exceeding 200,000 km^2, followed by Greece and Bulgaria with an area of over 100,000 km^2. The only Balkan states with a population exceeding 10 million inhabitants are Romania and Greece. In keeping with their GDP, the countries with the largest economies are Greece and Romania, followed at a distance by Croatia and Bulgaria. Except for Greece, all the other countries included in this study belong to the group of the former socialist economies. The transition from socialist economy to a market economy occurred at different speeds in each country; the

transition has been influenced by a complex internal and external factors. Political instability and military clashes have seriously affected the economy of the states in the former Yugoslavia. The attractiveness of the Balkan states for investors was determined by their ability to provide guarantees of peace and stability (Redzepagić and Vukotić-Cotič, 2009).

The Balkan states share the link with the European Union: some states are already members (Greece, Slovenia, Romania, Bulgaria, Croatia), others have the status of candidates (Albania, Macedonia, Montenegro and Serbia) or potential candidates (Bosnia and Herzegovina). The results can be found in the literature of researches on the synchronization of business cycles in the Balkan countries with the European Union and European Economic and Monetary. The results of such research show that between the countries in the region there are great discrepancies, given the varying levels of economic development, and also the degree of integration with the EU or Eurozone economy (Gouveia, 2014). Tourism development is an opportunity for the sustainable growth of the Balkan states. Therefore, the governments of the states in the region have developed strategies for tourism development (Metodijeski and Temelkov, 2014). The precarious economic situation of most Balkan states has led to underfunding of education. Krstic and Dzunic (2014) state that "when it comes to education as a basis for the development of the knowledge economy, the Western Balkan countries Observed lag significantly behind the EU in terms of investment in education".

The economic situation is also one of the causes of the demographic problems of Balkan states, alongside emigration and aging. Lukic et al., referring to the Western Balkans, shows that "depopulation is evident on the whole territory of West Balkans". Pilc (2015) tries to identify common determinants of the shape of labour market institutions in a group of 25 post-socialist countries during the transition period. The author concludes that "the levels of political liberty, protection of property rights, international trade freedom and government expenditures did not appear to have influenced the labour market institutions in these economies".

In economics literature the issue of the "reputation" of the region for investors is also tackled. Estrin and Uvalic (2013) examine whether one can talk about the Balkans exerting a negative effect on FDI given the image problems of the states in the region. The cited authors conclude that, in addition to the factors that are acting on FDI in other transition economies, in the Balkans there is also a negative regional effect.

2. METHODOLOGY, OR ABOUT THE METHOD OF STATISTIC PROFILE

In this paper we present and apply the profile method, which gives powers to permanently shape the real outer environment, of the educational, human, entrepreneurship, etc. milieu, as well as the country profiles. We consider that the statistical profile method is one of the simplest solutions that can be used successfully to analyse the situation and the perspectives of Balkan countries.

The new method of statistical profile is a statistical method of investigation and knowledge with a decision-making impact through which the function of information and decision is hypertrophied; the decision may be completely influenced by the profiles used to support the statistical confrontation or comparison. The typology of the profiles that can be used is very diverse, ranging from temporal or dynamic profiles to territorial or hierarchical profiles, from profiles of coordination defined by means of sharp differences, to profiles of intensity, from structural profiles, to average profiles, from profiles focused on extreme values (minimum and maximum), to demographic profiles, from econometric profiles to climate profiles or geographic profiles, etc. One can define various specific operations using profiles, from the intersection of some of them, to combining others, or the complementary of a profile, as operations similar to those in set theory. A standard profile comprises both a selection of the variables for building the profile, i.e. the subsequent operation to that of analysis of variance, and the final ordering of the variables of the profile in accordance with the values of the coefficient of determination, for the characteristics considered to be explanatory or assumed to be able to solve the emerging managerial problem that requires prompt decision-making. (Săvoiu et al., 2008). Along with the models and variables, even the methods can become multidisciplinary, in their use within several specific disciplines, or simultaneously within a multidisciplinary reality. As part of this picture, one can define methods that can be applied in a multidisciplinary manner, being able to implement the method or approach mostly in multidisciplinary areas" (Săvoiu G., Čudanov M., Vladu M., 2012, p. 36).

The relativity of the exhaustive type of knowledge, or that of comprehensive analysis, limitation or restriction as a result of the imperceptible presence of the unknown, they all permanently offer both analysts and practice-connected researchers, and also theorists, a chance to identify and seek new solutions, as the realm of the unknown never has precise limits or bounds. The limitation caused by the researcher's or theorist's abilities or skills is a millennial tribute serenely bought to those competent, and especially to their strict scrupulousness in assessing their own incompetence. In this respect the limits of their own competence and powers of the method of statistical profile are metaphorically highlighted by the traditional Confucian

recognizing reciprocity as an active management principle, being expressed synthetically by this formulation: "I remember the days when scribes left empty spots on the page…" (Confucius, in the *Analects*). If the essential means designed to conduct an act of research interpreted scientifically is the one provided by the method, then the limits conferred to analysis by the statistical profile method, used in this article, are all the more important: "We can study real things, palpable things, but if we do not study them in keeping with a rigorous scientific method, those studies are not science. It is not the object or the subject, but the method that determines science" (Odobleja, 1984). The argument of the conceptual simplification of the applied multidisciplinary method is given by the previous statements made by Ştefan Odobleja in 1984.

The approach based on the method of profiling could be considered also a synectic approach or solution. Gordon's *Synectics* is suitable and indicated for selecting a single instrument, idea, concept, method, etc., or for identifying an original solution, and generates stages that have already become classical in the innovative research processes: forming the synectic group of entities, presenting the hierarchy or modelling problem, setting the synectic itinerary, developing the problem solving model, and finally testing or validating and applying the model (Săvoiu et al., 2008; Săvoiu, Jaško and Čudanov, 2009).

From the analysis of the typology of the statistical profiles, given the inherent complexity of modeling, the macro-econometric profile emerges, mainly through identifying the level and the intensity of the energy dependence of GDP and import and export flows, on a macroeconomic level, depending on fuel prices in both Romania and Serbia. The econometric profile begins with correlation matrices and is completed by four successive models focused on fuel prices as an exogenous variable revealing the instrumental diversity existing within the statistical method in general. The databases used were mainly those available at World Bank http://data.worldbank.org/indicator/AG.LND.TOTL.K2, and also at ChartsBin, available on line at http://chartsbin.com/, and not least for the domain of energy and the dependence on oil and its derivatives (gasoline, diesel, etc.) available at https://www.giz.de/expertise/html/4282.html (offered to users by GIZ-International Fuel prices).

3. RESULTS AND DISCUSSION

First, the econometric profile of the energy dependence of the two national economies is presented. The profile of the dependence of Balkan economies on the cost of gasoline and diesel is relevant – the level of intensity of connections between GDP, export, import and fuel prices is high, i.e. above 0.75, with a trend of reaching near 1.00 value, especially in relation to the export flow (0.97-0.98).

The macro-econometric profile focusing on quantifying the intensity of energy dependence of Romania and Serbia (i.e. GDP and export and import flows, on a macroeconomic level), is based on the dynamics of fuel prices in the two economies. The interpolation was conducted by the method of average annual modifications, reconstructing, with some error (under 3%), a data series impossible to use in modelling and in drawing the profile confronted. The econometric profile method has recourse, as a first instance, to correlation matrices defined for the two economies (Table 1 and Table 2 for Romania to Serbia).

Table 1: Matrix of correlation (Romania)

	SER01	SER02	SER03	SER04	SER05
	Exports of goods and services	**Imports of goods and services**	**GDP (PPP-international $)**	**GDP per capita**	**Fuel price**
SER01	1.000000	0.968895	0.985179	0.969569	**0.964017**
SER02	0.968895	1.000000	0.966481	0.990420	**0.932306**
SER03	0.985179	0.966481	1.000000	0.981221	**0.961721**
SER04	0.969569	0.990420	0.981221	1.000000	**0.927678**
SER05	**0.964017**	**0.932306**	**0.961721**	**0.927678**	1.000000

Software used: E-Views

The econometric profile of energy dependence reveals four successive unique factorial competitive models with R squared values exceeding 0.86, and placed close to 0.93 in some the models typical of Romania. The econometric models that outline the profile of fuel price dependence, as an exogenous variable, are detailed in Table 3 for Romania and Table 4 for Serbia, and shows the diversity of existing tools part of the statistical method profile generally, and also the validity of the dependence on a level of intensity that is very high in statistical terms (the models are relevant in forecasts as well as scenarios or simulations correlated with expected developments on the market of oil resources, and especially fuels).

Table 2: Matrix of correlation (Serbia)

	SER06	SER07	SER08	SER09	SER10
	Exports of goods and services	**Imports of goods and services**	**GDP (PPP-international $)**	**GDP per capita**	**Fuel price**
	SER01	SER02	SER03	SER04	SER05
SER06	1.000000	0.963857	0.961261	0.953648	**0.950528**
SER07	0.963857	1.000000	0.965636	0.977119	**0.915656**
SER08	0.961261	0.965636	1.000000	0.939785	**0.969850**
SER09	0.953648	0.977119	0.939785	1.000000	**0.881686**
SER10	**0.950528**	**0.915656**	**0.969850**	**0.881686**	1.000000

Software used: E-Views

Compared to the econometric profile of the energy dependence of the Balkan economy in general, both Romanian economy and that of Serbia are placed on a high level of intensity of modeling, with a high forecasting and simulation valences, which must be capitalized in the medium and short term. The same thing has also been found through an approach based on statistical simplexity, however only with reference to the Romanian economy (Săvoiu, et al., 2015; Săvoiu, et al., 2016), and is reconfirmed for Serbia in a similar manner.

Table 3: Econometrical models based on fuel prices for GDP, Exports and Imports (Romania)

Dependent Variable: SER01 EXPORTS Method: Least Squares				
Sample: 1995 2014 Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.26E+10	3.47E+09	-3.629917	0.0019
SER05 Fuel price	4.89E+10	3.18E+09	15.38515	0.0000
R-squared	0.929329	Mean dependent var		3.54E+10
Adjusted R-squared	0.925403	S.D. dependent var		2.49E+10
S.E. of regression	6.80E+09	Akaike info criterion		48.21307
Sum squared resid	8.32E+20	Schwarz criterion		48.31264
Log likelihood	-480.1307	F-statistic		236.7027
Durbin-Watson stat	1.257934	Prob(F-statistic)		0.000000
Dependent Variable: SER02 IMPORTS Method: Least Squares				
Sample: 1995 2014 Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.03E+10	5.41E+09	-1.909530	0.0723
SER05 Fuel price	5.41E+10	4.95E+09	10.93659	0.0000
R-squared	0.869195	Mean dependent var		4.29E+10
Adjusted R-squared	0.861928	S.D. dependent var		2.85E+10
S.E. of regression	1.06E+10	Akaike info criterion		49.10087
Sum squared resid	2.02E+21	Schwarz criterion		49.20045
Log likelihood	-489.0087	F-statistic		119.6090
Durbin-Watson stat	1.186364	Prob(F-statistic)		0.000000
Dependent Variable: SER03 GDP Method: Least Squares				
Sample: 1995 2014 Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.25E+10	1.48E+10	2.197634	0.0413
SER05 Fuel price	2.01E+11	1.35E+10	14.88979	0.0000
R-squared	0.924908	Mean dependent var		2.30E+11
Adjusted R-squared	0.920736	S.D. dependent var		1.03E+11
S.E. of regression	2.89E+10	Akaike info criterion		51.10953
Sum squared resid	1.51E+22	Schwarz criterion		51.20911
Log likelihood	-509.0953	F-statistic		221.7058
Durbin-Watson stat	0.762601	Prob(F-statistic)		0.000000
Dependent Variable: SER04 GDP PER CAPITA Method: Least Squares				
Sample: 1995 2014 Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1287.249	678.5224	-1.897136	0.0740
SER05 Fuel price	6541.403	620.5706	10.54095	0.0000
R-squared	0.860586	Mean dependent var		5142.950
Adjusted R-squared	0.852840	S.D. dependent var		3463.541
S.E. of regression	1328.662	Akaike info criterion		17.31637
Sum squared resid	31776163	Schwarz criterion		17.41594
Log likelihood	-171.1637	F-statistic		111.1116
Durbin-Watson stat	0.901099	Prob(F-statistic)		0.000000

Software used: E-Views

As far as Serbia is concerned, the econometric profile of energy dependence reveals another four successive unique factorial models that are equally competitive, with R squared values exceeding 0.77, and placed close to 0.94 in some of the models.

Table 4: Econometrical models based on fuel prices for GDP, Exports and Imports (Serbia)

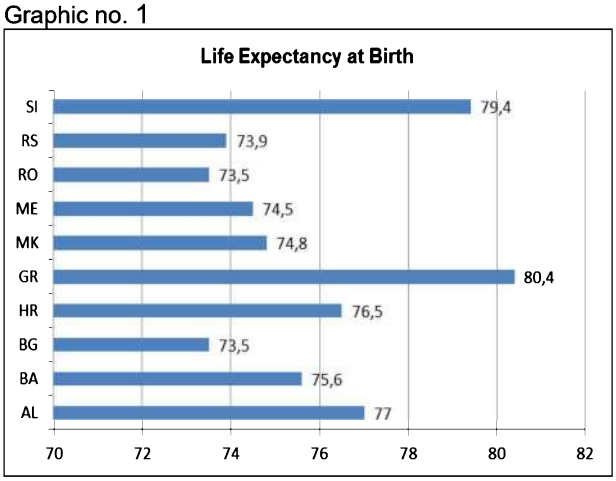
Dependent Variable: SER06 EXPORTS Method: Least Squares				
Sample: 1995 2014 Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.18E+09	9.90E+08	-3.217642	0.0048
SER10 Fuel price	1.18E+10	9.05E+08	12.98212	0.0000
R-squared	0.903504	Mean dependent var		8.37E+09
Adjusted R-squared	0.898143	S.D. dependent var		6.07E+09
S.E. of regression	1.94E+09	Akaike info criterion		45.70248
Sum squared resid	6.76E+19	Schwarz criterion		45.80205
Log likelihood	-455.0248	F-statistic		168.5355
Durbin-Watson stat	1.107542	Prob(F-statistic)		0.000000
Dependent Variable: SER07 IMPORTS Method: Least Squares				
Sample: 1995 2014 Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.38E+09	1.78E+09	-1.332665	0.1993
SER10 Fuel price	1.58E+10	1.63E+09	9.664573	0.0000
R-squared	0.838426	Mean dependent var		1.31E+10
Adjusted R-squared	0.829450	S.D. dependent var		8.45E+09
S.E. of regression	3.49E+09	Akaike info criterion		46.87887
Sum squared resid	2.19E+20	Schwarz criterion		46.97844
Log likelihood	-466.7887	F-statistic		93.40397
Durbin-Watson stat	1.227686	Prob(F-statistic)		0.000000
Dependent Variable: SER08 GDP Method: Least Squares				
Sample: 1995 2014 Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.37E+10	2.73E+09	8.691018	0.0000
SER10	4.21E+10	2.49E+09	16.88415	0.0000
R-squared	0.940609	Mean dependent var		6.51E+10
Adjusted R-squared	0.937309	S.D. dependent var		2.13E+10
S.E. of regression	5.34E+09	Akaike info criterion		47.72846
Sum squared resid	5.13E+20	Schwarz criterion		47.82803
Log likelihood	-475.2846	F-statistic		285.0747
Durbin-Watson stat	0.879548	Prob(F-statistic)		0.000000
Dependent Variable: SER09 GDP PER CAPITA Method: Least Squares				
Sample: 1995 2014 Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	713.0111	457.2398	1.559381	0.1363
SER10	3315.350	418.1875	7.927902	0.0000
R-squared	0.777370	Mean dependent var		3972.000
Adjusted R-squared	0.765002	S.D. dependent var		1846.979
S.E. of regression	895.3531	Akaike info criterion		16.52695
Sum squared resid	14429830	Schwarz criterion		16.62653
Log likelihood	-163.2695	F-statistic		62.85163
Durbin-Watson stat	0.942437	Prob(F-statistic)		0.000000

Software used: E-Views

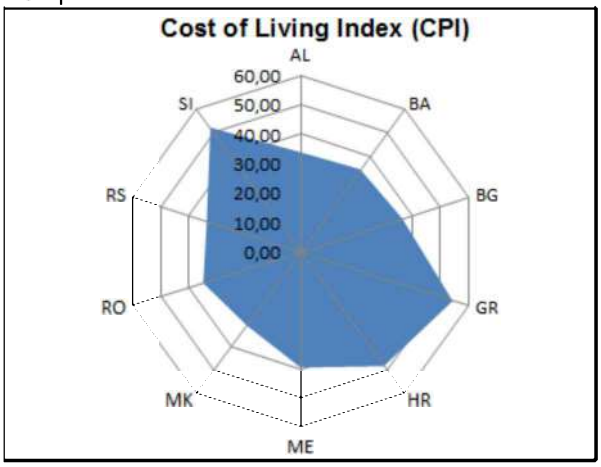
Detailed econometric profiles of Balkan entities (countries and economies placed within the area delimited in the introduction) are presented through representations in relevant graphical variants [Graphics no. 1 ÷ 10]. The statistical profile method applied to outline a Balkan pattern, and also some characteristic delimitations with reference to the economies of Romania and Serbia, succinctly reveals the following aspects through statistical confrontation of individual profiles in relation to the generic Balkan profile:

a) Synthetic evolution similarities in the Balkans (life expectancy at birth or LEB between 73.5 years and 80.4 years, and CPI within CLI between 31.10% and 54.50%):

Graphic no. 1



Graphic no. 2

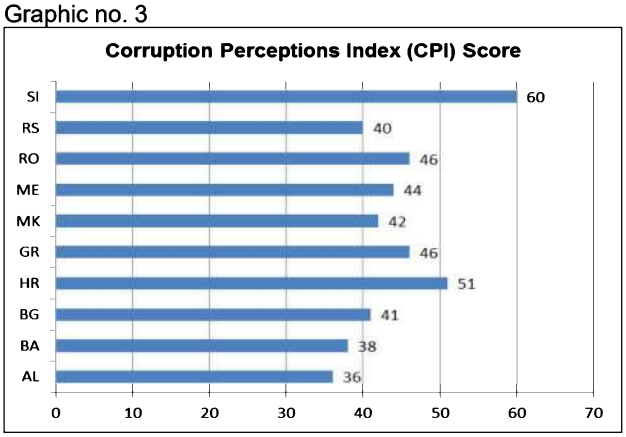


Sources: Life Expectancy at Birth in Years, ChartsBin.com, viewed 24th March, 2016, <http://chartsbin.com/view/33870> and Cost of Living Index 2016, ChartsBin.com, viewed 28th March, 2016, <http://chartsbin.com/view/39753>. Note*: RO and RS show very similar values in both statistical profiles (73.5 years and 73.9 years / 34.80% and 33.56%).

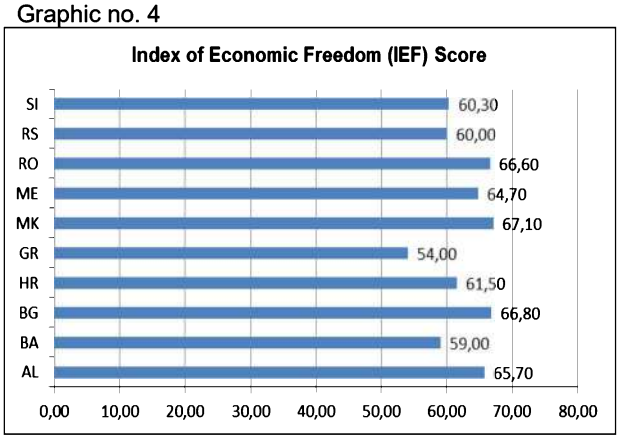
Cost of Living Index (CPI)

b) homogeneity in the Balkans in terms of Balkan profile of the population perception of corruption (8/11 of the populations of economies analyzed perceive a deep and aggravating internal corruption within a close interval between 36% and 46%, the CPI score being in inverse proportion to the minimum perception level, an index placed at 100%) and the profile of economic freedom (the range of variation is between 54% and 67.10%, with a low relative amplitude of about 20%):

Graphic no. 3



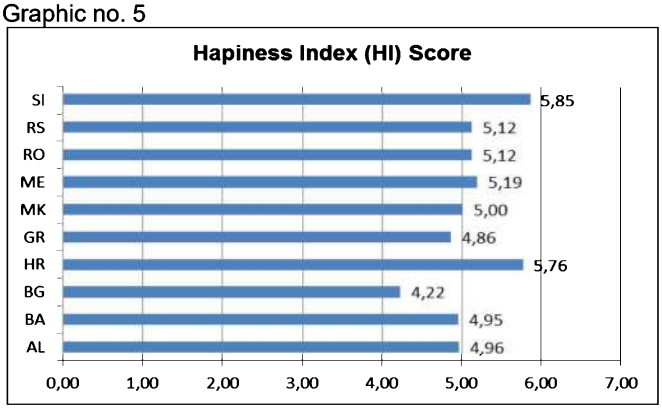
Graphic no. 4



Sources: Corruption Perceptions Index 2015, ChartsBin.com, viewed 25th March, 2016, <http://chartsbin.com/view/38836>. 2015 Index of Economic Freedom, ChartsBin.com, viewed 24th March, 2016, <http://chartsbin.com/view/38591>. Note *: RO and RS show relatively similar values in these statistical profiles (46% and 40% / 66.60% and 60.00%).

c) significant structural or temporal deviations in relation to the average EU-28 or EU-15 level are identified in the generic Balkan profile concerning happiness (except Bulgaria and Greece, all other Balkan countries have a happiness perception index, HI, much higher than that of corruption or life expectancy perception, standing at a level 10% lower than life expectancy in the EU-15); again structural deviations, this time related to income, are a major cause of a very low TTCI, as compared to the EU-15 average):

Graphic no. 5



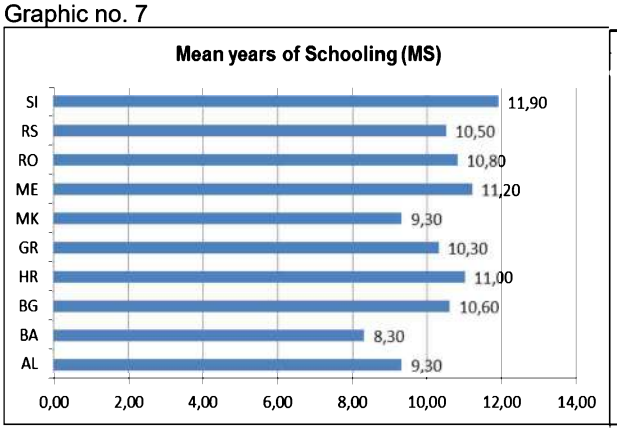
Graphic no. 6

Sources: World Happiness Index, ChartsBin.com, viewed 24th March, 2016, < http://chartsbin.com/view/38559> and Travel &

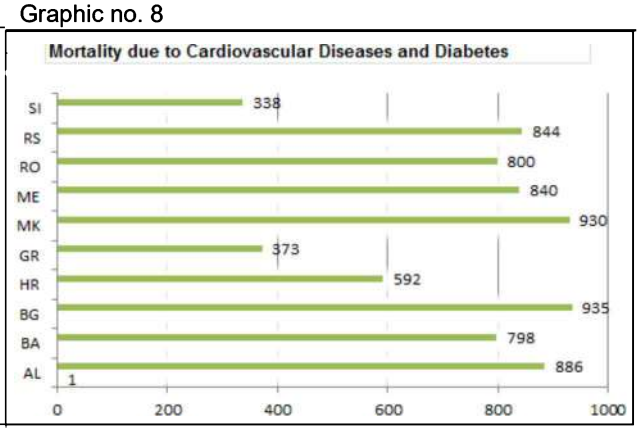
Tourism Competitiveness Index, ChartsBin.com, viewed 24th March, 2016, < http://chartsbin.com/view/38523>.
Note*: RO and RS show identical values in the statistical profile of the perception of happiness, HI, being deeply Balkan in spiritual terms (5.12), and relatively similar in the Travel & Tourism Competitiveness Index profile (TTCI) with 4 and 3.78.

d) relatively high statistical gaps between profiles that are individualized at the level of economy or country with values approaching 50% (the average length of schooling, or the average school years in the Balkan countries captures an obvious heterogeneity, but Romania and Serbia remain close in point of level, with the average of 10.8 years and 10.5 years, respectively) or even exceeding 100% in the profile of cardiovascular mortality and diabetes (the relative similarity is kept for Romania and Serbia):

Graphic no. 7



Graphic no. 8

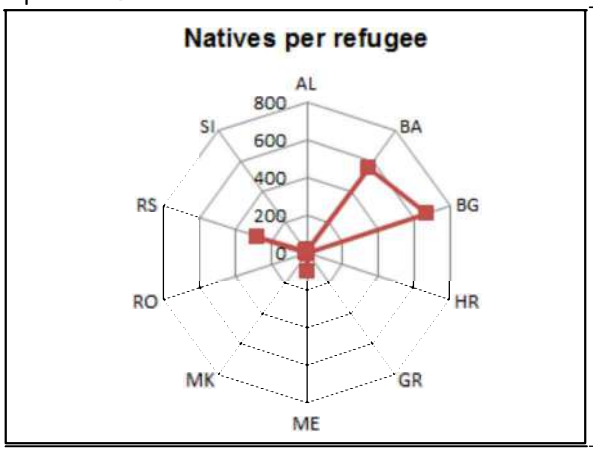


Sources: ChartsBin statistics collector team 2011, Mortality due to Cardiovascular Diseases and Diabetes, ChartsBin.com, viewed 24th March, 2016, http://chartsbin.com/view/2621, Human Development Index, ChartsBin.com, viewed 24th March, 2016, <http://chartsbin.com/view/38512>.

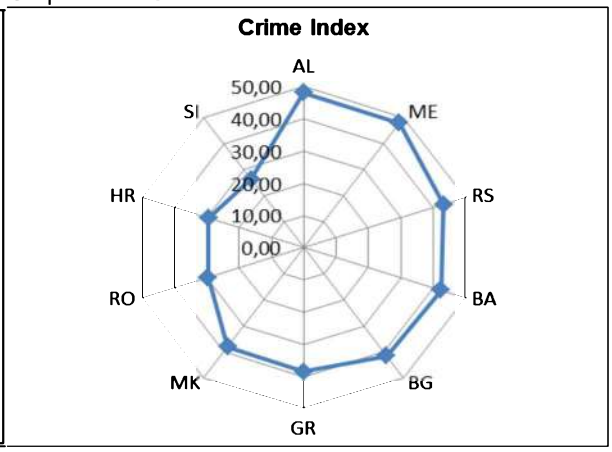
e) major disparities or inequalities between Romania and Serbia appear only circumstantially in the profile of migration perception term, and derived from there, in the profile outlining crime and implicitly personal safety, with emphasis on the Balkan corridor of Mediterranean immigration.

A more detailed and pertinent analysis, having a real statistical comparability comprehensively insured, will be able to perform with Serbia's accession to the European Union, in the context of a sharp relative convergence and common objectives of both economies, here distinctly profiled through the new method proposed in the article.

Graphic no. 9



Graphic no. 10



Sources: Crime Index for Country 2016, ChartsBin.com, viewed 28th April, 2016, <http://chartsbin.com/view/39717>. Refugee Population by Country of Asylum, ChartsBin.com, viewed 28th March, 2016, <http://chartsbin.com/view/39661>

4. CONCLUSION

There has been very much writing, sometimes too much, slightly tinged with irony or self-irony, and there is still as much writing about the existence of a Balkan spirit defining a Balkan model of a political, economic, social, educational, cultural, etc. specificity. Without exaggerating the importance of the method of the statistical profile in identifying and tentatively drawing this specific model, one in which economic freedom, the feeling of happiness on the one hand, and the average income or GDP per capita on the other hand, seem to be in a completely reverse relationship as compared to Central and Western Europe, one can finally make use of Basarab Nicolescu's concept of trans-disciplinary knowledge (lying at the intersection expressly formulated by Dan Barbilian the mathematician, alias Ion Barbu the poet) of a Balkan economy or country starting from Balkan nature generally.

In the process, and in the complex interstitial space of Isarlyk, the poet and mathematician Ion Barbu, a symbol of the Balkan Peninsula in Romanian poetry, and also of the Balkan spirit, an intoxicating and alluring component part is transposed, a part that is Peninsular and Mediterranean, mountainous through aspiration and also flat through survival, specific to thought, speech, human nature and action in the Balkans, which is identified by a special swinging, both normal and abnormal at the same time, between "abstraction and concreteness, the real and the imagined" (Nicolescu, 2013), and also between authenticity and borrowed thinking, between purity or ideal and compromise or contingent… The method of the statistical profile, emphasizing the importance of instrumental constructs as indexes the origin of which is purely sociological in this article, redraws a tumultuous and unpredictable, Balkan contours, difficult to understand from outside the economic entities of the peninsula, and yet representing the starting point of the history of science, modern education, but also some of the worst conflicts and disasters of a multi-millennial Europe.

REFERENCES

Estrin, S., & Uvalic, M. (2013). Foreign direct investment into transition economies: Are the Balkans different?. *LEQS Paper*, (64). Retrieved from: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2293100

Gouveia, S., (2014), Business cycle correlation between the Euro area and the Balkan countries, International Journal of Economic Sciences and Applied Research, 7 (1), 33-49, Retrieved from http://ijbesar.teiemt.gr/docs/volume7_issue1/business_cycle_correlation.pdf;

Griffiths, H., B. Krystufek, and J. Reed, eds. (2004), Balkan biodiversity: Pattern and process in the European hotspot. Dordrecht: Kluwer Academic Publishers.

Krstic, Bojan; Dzunic Marija (2014), Analysis of the Western Balkan Countries' Competitiveness Determinants Using the Kei Methodology, *Ecoforum*, 3(2), 69-76;

Lukic, T., Stojsavlevic, R., Durdev, B., Nad, I. and Dercan, B. (2012). Depopulation in the Western Balkan Countries, *European Journal of Geography,* 3(2), 6-23, Retrieved from http://www.eurogeographyjournal.eu/articles/Lukic,%20Stojsavljevic%20et%20al,%20Depopulation_FINAL.pdf;

Metodijeski, D., and Zoran T., (2014). Tourism policy of Balkan countries: Review of national tourism development strategies. *UTMS Journal of Economics*, 5 (2), 231–239, Retrieved from http://utmsjoe.mk/files/Vol.%205%20No.%202/2-10_Medodijeski-Temelkov2%281%29.pdf;

Nicolescu, B., (2013). Ion Barbu – Cosmologia "Jocului second", Craiova Editura Aius.

Odobleja, Ş. (1984). Introducere în logica rezonanţei, Craiova, Ed. Scrisul românesc;
Pilc, M., (2015). Determinants of the labour market institutions in post-socialist economies, *Communist and Post-Communist Studies*, 48(2-3), 97-112.
Redzepagić S., Vukotić-Cotič, G., (2009). Attractivity of the Balkan Countries for the Foreign Investors, Business Opportunities in Serbia: The Case of the Italian Business Sector and the Role of Management Education, 267-273;
Săvoiu, G., Čudanov, M., Vladu, M., (2012). Profile Method – an Example of Multidisciplinary Applied Method, *ESMSJ*, Vol. 2 (2), 36-45;
Săvoiu, G., Dinu, V., Gogu, E., Zurub, H., (2015). Econometric Micro- and Macroeconomic Modelling in Romania: Finding Simplicity in Complexity and Generating Statistical Simplexity, *Economic Computation and Economic Cybernetics Studies and Research*, 4/2015, 69-84, Retrieved from http://www.ecocyb.ase.ro/nr20154/05%20-%20SAVOIU%20Gheorghe,%20Vasile%20Dinu.pdf;
Săvoiu, G., Gogu, E., Ionescu, A., (2016). Tendinţe în comercializarea externă a României, după 1995, Romanian Statistical Review - Supplement no. 3 / 2016, 11-26, Retrieved from http://www.insse.ro/cms/sites/default/files/field/publicatii/revista_romana_de_statistica_supliment_nr.3_2016.pdf;
Săvoiu, G., Jaško, O., Čudanov, M., (2009). Diversity of scientific quantitative, statiscal, and social methods, techniques and management models in management system, *Management*, 52, pp.5-15;
Săvoiu, G., Jaško,O., Dulanović, Z., Čudanov, M., Craciuneanu, V., (2008). The value of general methods, quantitative techniques and management models in professionalizing management, *Management*,(49-50), Belgrade, 5-12.
Săvoiu, G., Manea, C., Simoni, S., (2008). The Demographic, Sociological and Geographical Profile. The Role of the Profile Method in Contemporary Management, *The 14th International Conference Nicolae Bălcescu Land Forces Academy Sibiu*, 27-29.1. 2008, Vol III, 185-199.

INTERNATIONAL TECHNOLOGY TRANSFER AND SPILLOVERS IN MERGERS AND ACQUISITIONS

*[1]Nemanja Kijanović
[1]Faculty of Organizational Sciences, University of Belgrade,
NGO- Narodna Tehnika Vračara
*Corresponding author, e-mail: nemanja.kijanovic6@gmail.com

Abstract: *This Paper explores technology transfer and spillovers when a company adopts the strategy of Merger and Acquisition (M&A) and gives us an insight into International Business arrangements that shape the business practice today. Companies are engaging in M&A with complex goals of entering new markets, improving and strengthening their technology and knowledge base, ultimately leading to competitiveness rise. The International Business literature has already acknowledged some positive outcomes for companies actively engaged in M&A, so we would pay special attention to technology spillovers, transfers, factors, and reasons of companies using these methods for improvement. The aim of this research is to deepen knowledge about M&A, to present technology transfer as one of the main reasons for companies doing M&A and to identify factors that are crucial for these companies' reactions.*

Key words: *International Business, Merger and Acquisition, technology transfer, spillovers*

1. INTRODUCTION

Nowadays, Multinational Companies (MNC) are aware of the importance of managing technology transfer as many of them review carefully all the factors before taking action. International technology transfer became a very popular theme for discussion among professors, students, business people, managers, and other stakeholders. Technology transfer is a process of transferring skills, knowledge, technologies, methods of manufacturing, employee's know-how, samples of manufacturing and facilities among Enterprises, Multinational companies, Universities, Countries... There are two kinds of technology transfer: horizontal and vertical technology transfer. Horizontal technology transfer is intentionally transmitted between countries and firms therefore we define "technology transfer" as a direct type of spillovers that occurs voluntarily from technology source to recipient. For example, Multinational firm transfer knowledge to local firm affiliating with supplied equipment (such as machines, equipment or manual) and with the form of software, know-how, patents, knowledge, and skills provided by education and training activities. Vertical technology transfer refers to the transfer of technology from Basic Research to Applied Research to development and then to production. It is the transfer of a pre-commercials technology from individual or institutional investor to an organization (L. Jakšić, et al., 2015). In this process, there are three factors that play an important role in technology transfer: the source, the recipient, and the technology itself. (Sonmez, et.al.2013)

There is long-term effect of spillovers and technology transfer when MNC acquire other company in order to use their technology potentials and to expand their business. The M&A are very interesting strategies and part of doing business today and it can be made for many reasons, but for us, the focus will be on technology and technology transfer reasons.

There are two main research objectives in this paper:

1) This paper is going to present technology transfer and spillovers of technology and knowledge as one of the main factors for MNC to execute M&A.

2) The second objective is to see potential progress, possibilities, and factors which influence on companies to apply M&A strategy and to make technology transfer and spillover effect.

1.1 Background of the study

Theoretical background of the technology transfer and spillover will give us better understanding of these subjects. Technology diffusion may rely on transfers or spillovers. (Keller, 2004) Technology transfer refers

to any process by which one party gains access to a second parity's information, and successfully learns and adsorbs it into his or her production function. Taschler and Chappelow defined technology transfer as the interpersonal, managed, and systematic process of passing control of a technology from one party to its adoption by another party. (Journal of Technology Transfer, 1999)

Research and development spillovers have been a major topic in the productivity, growth, and industrial organization literature for many decades. Technology transfer and spillover effect are happening in many situations but for us, the most interesting is when a company does M&A. What is a merger and what is an acquisition? The merger is when two companies join to create a new entity. In an acquisition, one company acquires sufficient shares to gain control of the other company. (Evans et. al. 2011) There are three types of M&A: horizontal, vertical, and conglomerate. Horizontal M&A are companies in the same line of business, often competitors. Vertical M&A means that companies are in the same line of production e.g., supplier or customer. Conglomerate merger refers to companies that are making M&A in unrelated lines and types of business, which are often motivated by acquired company's growth. (Clayman et al., 2008)

2. PROBLEM IDENTIFICATION

While many empirical studies appear to support the presence of technology spillovers, there remains a major problem at the heart of the literature. This arises from the fact that R&D generates, at least, two distinct types of "spillover" effects. The first is knowledge (or technology) spillovers that may increase the productivity of other company that operate in similar technology industry. The second type of spillover is the product market rivalry effect of research and development. Technology spillovers are beneficial to other companies, but R&D operations by product market rivals have a negative effect on a firm's value due to business stealing. Despite much theoretical research on product market rivalry effects of R&D, there has been little econometric work on such effects, in large part because it is difficult to distinguish the two types of spillovers using existing practical strategies. (Bloom, Schankerman, and Reenen, 2010)

The decentralization of R&D by multinational enterprises, for example the establishment of laboratories outside the parent company's home country, or the acquisition by foreign firms of R&D laboratories belonging to companies which were controlled by residents, are clearly not new phenomena. So far decentralized R&D has already been underpinned in some cases and accompanied by the tendency of shifting the relocate production. While the growth of this phenomenon is recognized, there is a need to assess the significance of that growth and its impact on different countries' technological and innovative capacity of MNC. The main question to prove that technology transfer is one of the main factors for company's decision to do M&A is: what is the growth of R&D in correlation with M&A arrangements and how far does it extend? (OECD, 2005)

With increasing competition at today's global markets, many firms and MNC choose to merge with one another to be able to compete internationally. M&A occur on all the markets and in all the types of industries, and that's why it's so interesting subject for discussion. In such competitive market there are a lot of questions, concerns, and problems and on some of them, we will give answers. Furthermore, we want to get insight into factors that contributed in increased cross-border M&A and technology transfer spillover. Managing mergers and identifying transformational value opportunities that stretch a company's capabilities in new ways require a dramatic change from the traditional approach to integration that has emerged as a best practice over the past 10-20 years. Companies were using templates, checklists, strong process management, and other methods to avoid risk but even now, this approach produces 66-75 percent of M&A failure rates. (McKinsey & Company, 2010)

3. CRITICAL ANALYSIS

Mergers and acquisitions are a popular mode of investment for firms wishing to consolidate, protect, and advance their global competitive positions, by acquiring strategic assets that enhance their competitiveness and selling off divisions that fall outside the scope of their core competence. For those firms, the "ownership" assets acquired from another firm, such as established brand names, technical competence, and existing distribution systems, and supplier networks can be put to immediate use towards better serving global customers, expanding market share, enhancing profits, and increasing corporate competitiveness by employing international production networks more efficiently. Most large-scale cross-border M&A have taken place in the energy distribution, pharmaceuticals telecommunications, and financial services industries. Small and medium-sized firms appear to have played a significant role in the growth of cross-border M&As

as well, particularly in the electronics, business services, personal services, distribution, healthcare, engineering industries and construction. (UNCTAD, 1996)

Growth of the main R&D sectors in the OECD area

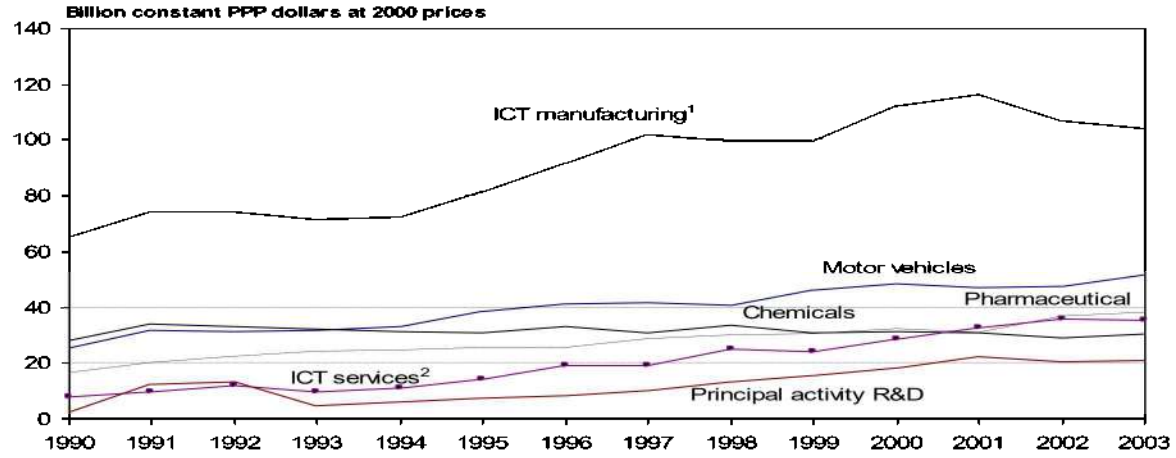


Figure 1: (OECD et al., 2005)

We can see from the table that there are big changes during the years in R&D, and we can notice that it matches with another literature in this paper and R&D rise is expected in the future too because of technology transfer and spillover that foreign companies bring in the host country. Furthermore, we will take a look into another table where is shown an inward cross-border M&A where we could get better insight into extending of technology transfer and spillover effect.

Inward cross-border mergers and acquisitions to G7 countries, (1995-2004)

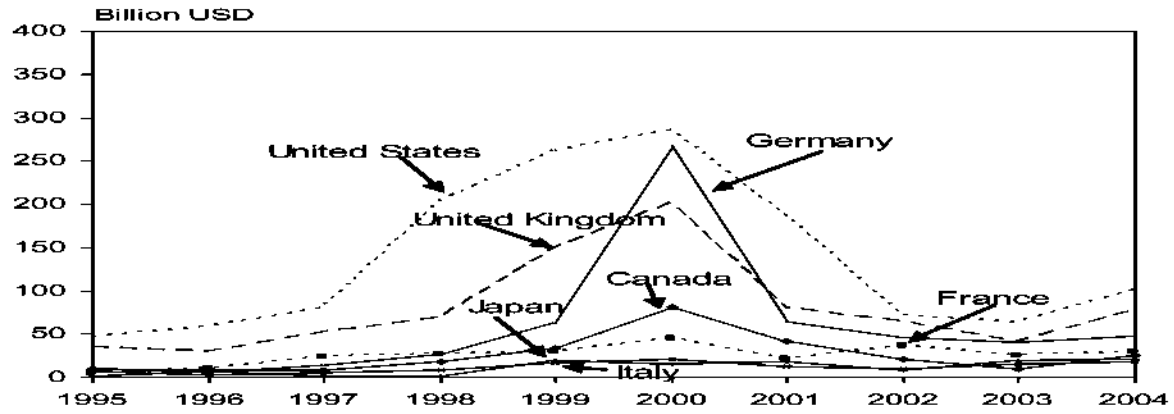


Figure 2: (OECD et al., 2005)

We can notice that these industry sectors were mentioned in the previous figure of R&D industries sectors which means that these trends were connected. From these facts, we can conclude that there is a big correlation between International M&A and technology transfer which confirms our first thesis.

3.1 Examples of successful and failed M&A

Disney-Pixar

The example of the successful merger is Disney-Pixar. The merger of legendary Walt Disney and Pixar was very good move from both sides. Disney acquired Pixar for 7.4 billion dollars in 2006 which made Disney largest shareholder. With the merger, the two companies could collaborate easily and freely. Pixar was American computer animation film studio based in California and after transaction they had produced many films that were very successful. Pixar has certainly gained the expert advice from Disney when it comes to

advertising and merchandising. When it comes to marketing to children, no one does it better than Disney. (Ruesink, 2009)

We can say that this project was quite conditioned by the technological superiority of both companies that manage to use this merger for filling gaps in their value chain because both parties were lacking some part of the business and that's why this merger was successful.

DaimlerChrysler

In 1998 Daimler bought Chrysler for $37 billion and idea was to form Trans-Atlantic Company which would dominate in the market, but in 2007, Daimler Benz sold Chrysler to the Cerberus Capital Management firm, which specializes in restructuring troubled companies, for $7 billion. Chrysler was nowhere near the league of high-end Daimler Benz. (Ruesink, 2009)

The plan was for Chrysler to use Daimler components, parts, and even car architecture to reduce sharply the cost to produce future automobiles. But problems surfaced when Daimler's Mercedes-Benz luxury division, whose components Chrysler would use, was unwilling to share with its mass market partner. In the end, Chrysler got only some steering and suspension components, a diesel engine, a transmission, and some purchasing deals. In return, Daimler had expected that Chrysler would dramatically increase its footprint in the promised land of auto sales in North America. But thanks in large part to stiff competition from Asian auto-makers, Chrysler fell short. Billed as a "merger of equals," the $36 billion deal turned out to be anything but, professionals said. Soon, control of the combined corporation fell to Daimler. (Mateja, 2007) This is perhaps one of the best examples of how problems can arise due to the motives of companies to improve their technological base by technology transfer.

4. CASE STUDY EXAMPLE OF TECHNOLOGY TRANSFER IN M&A

4.1 The rise of chip design in Asia: Case Study

Chip design is a good example to illustrate the complex interaction of factors currently favoring the expansion of innovative R&D in developing countries. Chip design not only creates the greatest value in the ICT industry while requiring highly complex knowledge, but it also involves a generic technology that affects a large number of user industries, including high-value services. Chip design has recently moved from centers of excellence in the Europe, United States, and Japan to sites in some developing countries, notably in South-East and East Asia. South-East and East Asia are now the fastest growing markets for electronic design automation tools, expanding by 36% in the first quarter of 2004 compared to 5% for North America, 4% for Europe, and -2 % for Japan. (EDA Consortium 2004)

This section explores the main drivers behind the technology transfer of chip design, drawing on interviews with 60 companies and 15 research institutions in the United States and Asia involved in designing integrated circuits, as well as systems. The Case Study includes global and regional carriers of chip design in Asia, including specialized research institutes and nine strategic groups of firms that participate in global design networks. The expansion of chip design and huge technology transfer and spillover in Asia has been the result of the synergistic effects of pull factors, policy factors, push factors and enabling factors.

Pull Factor- The cost of employing a chip design engineer in Asia is much lower than in the United States. MNCs need to locate design department near the rapidly growing Asian markets for computing, communications, and digital consumer equipment to interact with the lead users of new products. Furthermore, most of the equipment is produced in China, and the country has become the world's third biggest market for semiconductors, generating considerable demand for chip design.

Table 2: (UNCTAD 2005) Annual cost of employing a chip design engineer, including salary, benefits, equipment, office space and other infrastructure, 2002 (Dollars)

Location	Annual cost
United States (Silicon Valley)	300 000

Canada	150 000
Ireland	75 000
The Republic of Korea	65 000
Taiwan Province of Chine	60 000
India	30 000
Chine (Shanghai)	28 000
Chine (Suzhou)	24 000

Policy factor- Policies cover a wide range of factors, such as regulations, incentives, education and infrastructure they were all designed to attract R&D and other MNC innovative activities, including chip design, to particular locations. The progress in chip design has owed much too concerted efforts by both leading companies and governments to establish new sources of global standards and innovation.

Push factors- Some factors in developed countries are also greatly contributing to pushing firms to expand chip design in Asia. Three such push factors can be distinguished:

- Changes in the organization and methodology of chip design; since the mid-1990s growing pressures to improve design productivity, combined with increasingly demanding performance features of electronic systems, have produced turbulence in chip design methodology.

- Changing skills requirements; the expansion of chip design in Asia appears also to have been influenced by a perceived inflexibility on the part of design engineers in the United States and Europe to adapt to a better work organization (termed "innovation factory") and more structured ("automated"). MNCs have also searched for lower design costs by increasing the workloads and decreasing the design engineers' salaries, which rose rapidly.

- More outsourcing and multiple design interfaces because before companies system and integrated device makers did almost all their chip design in-house.

Enabling factors- Finally, new IT Companies facilitate the internationalization of chip design. Coordinating specialized design networks in Asia vertically can involve high communication costs (education systems, labor markets, corporate governance, regulatory and legal systems as well as Intellectual Property Rights protection). A second enabling factor is a spread of "transnational knowledge communities", such as professional and skilled staff. (UNCTAD, 2005)

Table 3: (UNCTAD, 2005)

In sum, in the case of chip design, a combination of pull, push, policy and enabling factors is creating a compelling case for MNCs to shift more of their design work to Asia. The trend is still at an early stage but is set to deepen. Over the past few years, all interviewed MNCs made substantial investments in chip design in Asia and were planning further expansion.

5. RESEARCH RESULTS AND ANALYSIS OF FINDINGS

5.1 Benefits from technology transfer

The internationalization of technology may help host countries move up the value chain and enhance competitiveness. Industrial competitiveness involves four interrelated types of upgrading: process upgrading, product upgrading, functional upgrading (new mix of activities or different activities in the value chain) and chain upgrading (moving to a new value chain in products of higher technology intensity) (UNCTAD, 2005). The home countries of MNCs face benefits and costs when their firms expand R&D abroad. The benefits are that R&D abroad may lead to reverse technology transfers, lower costs and, therefore, increased R&D, leading to improved competitiveness of the MNCs (which can also benefit other firms in the home country). However, such a reverse transfers are likely to be significant only if the host country is technologically advanced.

Improved overall R&D efficiency-R&D grows more complex, companies tend to use a more diverse set of information, skills, and knowledge. The availability of research workforce or a knowledge base abroad can accelerate new product development. Lower costs in developing countries can also make R&D more

economical. (UNCTAD, 2005) From the literature, we can conclude that the role of technology deals can expand company's competitive advantage, and there is also the advantage of co-funded programs with regarding strong incentives. This will also help to utilize the full potential advantage for public & private needs. Technology transfer creates a new market and also develops the needs of the consumer. Technology transfer can be effective for sustainable economic growth in the future development as well as the commercialization of new technologies.

5.2 Drawbacks of technology transfer

When MNC invest enough money and start operating in a foreign country after some time, it can make big problems that the company may not be able to control. For instance, the movement of labor from MNC to a domestic firm may enable the letter to benefit from the training and knowledge that the employee would have acquired from their time spent at the MNC and also a level of awareness about the knowledge that the MNC possesses is transferred. (Jones, Wren et al. 2007)

There is a big financial risk involved because licenses agreement can generate income, but patent applications that did not get licensed out will just cost money and in the case of MNC and International Business the extend of these loses could be huge. Especially if we take into account the ruthless competition that would try to use their weakness.

The controlling of the cost is the difficult and challenging task. MNC is exposing its know-how and technological abilities in M&A arrangements which mean that they are vulnerable to the pressures of competition that implies that they have easier access to market information. There is also the probability of high industry losses as well as inconsistent profits availability that could be major disadvantage. Technology transfer activities may put shareholders, companies, managers, and researchers in conflict of interest situations because each of them could strive for their benefits, especially when transfer involves M&A or creation of a spin-off company. Institutions should be aware of these possible dangers and anticipate them by elaborating a detailed conflict of interest policy. (Inzelt, Hilton, et al. 1998)

6. CONCLUSION

The purpose of this thesis was to explain international technology transfer and spillovers in M&A arrangements and to identify factors, problems, and reasons why companies use these strategies for improvement. Summing up various statements of different authors and considering best practice examples, it is needless to say that technology transfer represents modern trend that helped many companies to gain significant revenue and to expand their business worldwide. We gave recommendations based on problems and critical analysis which should help MNC to make better M&A in future.

We also found a huge correlation between international technology transfer and M&A strategies that are more numerous, regardless of their not-so-great percentage of success. The internationalization of R&D by MNCs opens up new opportunities for developing countries with strong skills and a technological base to enhance the development of their innovative capabilities. MNC will always search for a better place to deploy their technology, to use local technological know-how, and to decrease their expenditures and that could be the chance for developing countries. The work of this thesis has covered an interesting field of research, and there is a lot more we wish we were able to discuss. This topic will also be valid in the future in business life and the subject of many studies because it has great potential and opportunities for development.

REFERENCES

A new generation of M&A: A McKinsey perspective on the opportunities and challenges, (2010), McKinsey & Company

Beule, D. F. and Nauwelaerts, Y. (2013), Innovation and Creativity, Pillars of the Future Global Economy, Edward Elgar Publishing,15-43.

Bloom, N., Schankerman, M., and Reenen, V. J. (4 August 2010), Identifying technology spillovers and product market rivalry, ESRC, (http://www.parisschoolofeconomics.eu/IMG/pdf/bsvr_final.pdf)

Clayman, R. M., Fridson S. M., Troughton H. G., (June 2008), Corporate Finance: A Practical Approach, CFA Institute, Chapter 10

Croson, R., Gomes A., Mcginn L. K., and Noth M. (2004), Mergers and Acquisitions: An Experimental Analysis of Synergies, Externalities and Dynamics, Review of Finance, v8, 481–514.

EDA Consortium (August 2004), Market Statistics Service Survey (San José: Electronic Design

Automation Consortium)
Goedhart M., Koller T., and Wasseles D. (July 2010), the five types of successful acquisitions, Mc Kinsey& Company Article, (http://www.mckinsey.com/insights/corporate_finance/the_five_types_of_successful_acquisitions)
Evans P., Pucik V., and Bjorkman I., (2011), The Global Challenge, International Human Resource Management, Second Edition, 525-565.
Inzelt A. and Hilton J., (November 1998), Technology transfers: From Invention to Innovation, Springer Science and Business Media, B.V.
Jones J., Wren C., (November 2007), Foreign Direct Investment and the Regional Economy, University of Newcastle upon Tyne, UK, 83.
Keller W. (September 2002), International Technology Diffusion, Journal of Economic Literature, 752-782.
Levi Jakšić M., Marinković S., and Petković J. (2015), Menadzment inovacija i tehnološkog razvoja, FON, 102-136.
OECD, (2005), Handbook on Economic Globalization Indicators, Paris: OECD (http://www.realinstitutoelcano.org/materiales/docs/OCDE_handbook.pdf)
OECD Observer, (2011), Merger soar, (http://www.oecdobserver.org/news/fullstory.php/aid/3615/Mergers_soar.html)
Pavlinek P., and Zızalova P., (14 October 2014), Linkages and spillovers in Global Production Networks: firm-level analysis of the Czech automotive industry, Journal of Economic Geography,1–33.
Sonmez A., (2013), Multinational Companies, Knowledge and Technology Transfer: Turkey's automotive industry in Focus, Springer International Publishing, 11-15.
Taschler D. R. and Chappelow C.C, (1999), Intra-company technology transfer in a Multinational Industrial Firm, Journal of Technology Transfer, 29-34.
UNCTAD, (1996), Investment, Trade and International Policy Arrangements, World Investment Report 1996, New York, United Nations, (http://unctad.org/en/Docs/wir1996_en.pdf)

OVERVIEW OF AIRLINE FLEET OWNERSHIP STRUCTURE

Slavica Dožić*, Radovan Krnić
University of Belgrade – Faculty of Transport and Traffic Engineering, 305 Vojvode Stepe Street, Belgrade, Serbia
*Corresponding author, e-mail: s.dozic@sf.bg.ac.rs

Abstract: *Airlines have recorded a significant increase in aircraft leases in recent years. In order to respond to market changes and offer corresponding capacity as promptly as possible airlines need flexible fleet. Flexibility which aircraft leases provide has motivated the authors to analyse fleet ownership structure. This paper gives an overview of airline fleet ownership structure, underlining differences that depend on business model, geographic distribution and alliance membership of large (more than 100 aircraft), medium (from 50 to 99 aircraft) and small (less than 50 aircraft) airlines. The analysis has shown that large airlines have a small percentage of leased aircraft, and vice versa, small airlines have a large percentage of leased aircraft. Moreover, it is noted that North American airlines have, in general, a smaller percentage of leased aircraft, and that membership in an alliance does not affect the fleet ownership structure.*

Keywords*: aircraft lease, low-cost airlines, full service airlines, geographic distribution, alliance membership*

1. INTRODUCTION

Constantly changing global airline market forces airlines to improve their levels of service in order to retain or even to strengthen the existing position. Nonetheless, airlines need to consider both passengers' and their own interests. They also need to satisfy different operational requirements and to make profit. Whereas the growth in air travel passenger demand (according to the International Air Transport Association – IATA) is expected to more than double in the next two decades with a 3.8% average annual growth (2014 baseline year), airlines need to adjust the capacity they offer. In order to accommodate rising demand, changes in fleet size/structure are needed. Therefore, airlines may need to acquire an aircraft.

According to Holloway (2008), there are two main reasons for aircraft acquisition: replacement of existing capacity and capacity growth. An aircraft should be replaced because of inappropriate characteristics, and more effective aircraft which will have the same mission should be placed in the fleet. Capacity growth could be growth within the existing network driven by the increase of demand. Moreover, growth could be induced by introducing a new service such as, for example, long haul or ultra-long haul routes. An airline can use different sources to finance an aircraft acquisition. Aircraft acquisition can be financed from the airline's own internal funds, or mixed internal funds and debt; furthermore, leasing options, which are the focus of this paper, could be used.

Air travel demand is directly affected by permanently varying conditions in the airline market. In order to respond to these changes and offer corresponding capacity as promptly as possible airlines need flexible fleet. With flexibility being an important issue, aircraft lease appears to be a suitable option for airlines. Whereas decisions related to aircraft lease are financial and connected to the airline policy, it is not surprising that appropriate data are, usually, unavailable. The airlines' reluctance to share their data limited our work to an overview, rather than modelling. Hence, the purpose of this paper is to review and analyse airline fleet ownership structure, namely to indicate the share of owned and leased aircraft in the airlines' fleet. Airlines included in the analysis are seated in different regions and have different business models. We distinguished between low-cost and full service airlines on the European and American market. Whereas most airlines tend to join an alliance, we found it reasonable to analyse fleets of member airlines.

After the introduction, literature review and the main definitions are given. The third section presents an overview of leased fleet depending on airline business model and geographic distribution. Finally, the last section points out concluding remarks and paper contributions.

2. LITERATURE REVIEW

Although available airline data related to financial information is rather limited, certain researches have been conducted and presented in the academic literature. Vargas and Saaty (1981) apply the Analytic Hierarchy

Process (AHP) to structure the problem and decide whether to lease or buy fleet in industry as a whole (not specifically for the airline industry). They suggest that, apart from economic factors that affect the final decision, non-economic factors such as company image, comfort and performance need to be considered because of their impact on the final decision. Oum et al. (2000) focus on operational effects of aircraft leasing rather than on financial implications. They indicate that for an airline which needs additional capacity leasing of aircraft represents a better option than buying, because a large leasing company can provide aircraft in short time periods and at lower prices than the manufacturers. Furthermore, they point out that an operating lease gives airlines the flexibility to accommodate their fleet as air travel demand changes, in order to adjust their capacity and demand. The authors develop a model which offers optimal share of owned-leased aircraft in the fleet, considering that air travel demand is uncertain and cyclical. Empirical results based on the data from 23 leading airlines indicate that optimal share of leased aircraft would be in the range between 40% and 60%. Gibson and Morrell (2004) indicate the advantages of operating lease over purchasing of an aircraft and, also, emphasize the issue of fleet flexibility provided by operating leases. They observe that airlines use operating leases for flexibility when adopting a new aircraft type.

Financial decisions should be made depending on airline's finances, its credit rating, as well as market conditions and global economy. In downturns of the economy, aircraft lease is a better option compared to buying the aircraft (Vasigh et al., 2012). However, financial decisions are not subject to long-term planning and should be made when acquisition procedure starts. It is noticeable that airlines operating the same market with the same business model have different shares of leased and owned aircraft (Mancilla, 2010), i.e. the ownership structure is not dependant on the fact whether the airline is full service or low-cost, as well as on geographic distribution.

Different researchers deal with optimization problems in order to help airlines make the right decision at the right time. They answer the question when an airline should be purchased, leased or retired. Hsu et al. (2011) propose a stochastic dynamic programming approach to aircraft replacement scheduling. The model is used to optimise airline's decisions related to purchasing, leasing or disposing of aircraft over time. The model was applied to an airline in Taiwan, and showed a growing interest for leasing over buying, especially in the time of severe demand fluctuations. Bazargan and Hartman (2012) propose a binary-integer programming model that minimizes total discounted costs over the planning horizon. The model is used for strategic fleet planning to help airline planners decide how many aircraft should be bought, leased and sold in the time period considered. After applying the model to two US airlines with different business models (full service and low cost) and after analysing the results obtained, the authors conclude that the solutions are similar for both business models. The recommendations they arrive at are the following: a new aircraft is favoured both for leasing and buying, short term leases are preferable, aircraft older than 12 years should be sold, fleet diversity is not encouraged, and leasing is a preferable option in comparison with buying. Analysis of airlines also shows that low-cost carriers have greater percentage of leased aircraft in comparison with the full service airlines, which is in contrast to previous research (Mancilla, 2010).

In view of the relevant literature cited above, one can conclude that aircraft lease has been playing a greater role in recent years in the airline market, which has motivated the authors to research it. Before the overview of airline fleet ownership structure is presented, it is necessary to give certain definitions related to aircraft lease and airline business models.

2.1. Main definitions

An aircraft lease will be defined as a contract whereby the owner of an aircraft (the lessor) grants to another party (the lessee) the exclusive right to the use of the aircraft for an agreed period, in return for the periodic payment of rent (the fee) (Morrell, 2013). Essentially, there are two basic forms of aircraft leasing, operating and financial. Wet, dry, cross-border and sales/lease back are forms of leasing which can be arranged through operating and finance agreements.

According to Morrell (2013), a finance or capital lease is an agreement signed for the period between 10 and 26 years, which means that it is a long term agreement. The lessee cannot cancel the financial lease or can do it only with a major penalty. In this arrangement the airline (lessee) enjoys some of the benefits and faces some of the risks of ownership. In contrast, the operating lease is a shorter term agreement (usually between one and seven years, or an average of five years), whereby the lessee can cancel the agreement and return the aircraft to the lessor without major penalty (Vasigh et al., 2012). Because of its flexibility, the operating lease is a common option for airlines. This statement is confirmed by the Boeing Capital Corporation, which indicates that the percentage of active global commercial aircraft fleet under operating leases has grown faster in recent years. Considering the period from 1980 to 2014, the increase from less than 2% in the 80s,

to approximately 40% by 2014, has been recorded. It is forecasted that operating leasing will account for 50% of the in service fleet by the end of this decade.

With regard to airline business models, in this paper we distinguish two of them: full service and low-cost. A full service airline is "an air carrier, typically a traditional national or major carrier that operates on a relatively extensive route network (thus also referred to as a network carrier) and provides a full range of services including different seating classes, in-flight entertainment, meals and beverages, on-board store, and ground facilities such as waiting lounges for premium class passengers or frequent flyer programme members" (ICAO, 2004). According to this document, a low-cost airline is defined as "an air carrier that has a relatively low-cost structure in comparison with other comparable carriers and offers low fares and rates".

The following section gives an analysis of airline fleet ownership structure. Due to unavailability of the corresponding data, the above defined leasing forms will not be separately presented. Hence, we will analyse the ownership structure regarding the number/percentage of leased aircraft in total.

3. ANALYSIS OF AIRLINE FLEET OWNERSHIP STRUCTURE

From the supply side, lessors (leasing company) offer their aircraft (capacity) in the market, where airlines appear on the demand side as players who need additional capacity. Whereas air travel demand is mainly influenced by economic factors such as gross domestic product (GDP), and air travel demand further influences aircraft demand, it is expected that the shape of GDP curve is very similar to the shape of lease rentals of the leading leasing companies (BBAM, AerCap, AWAS). According to the World Bank's (2016) definitions, GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products, while GDP per capita is gross domestic product divided by midyear population. Our findings (Figure 1) confirmed this statement, with significant values of coefficients of correlations between GDP and lease rentals by leasing companies BBAM, AerCap, AWAS given respectively: $r_{GDP,\ BBAM} = 0.83$, $r_{GDP,\ AerCap} = 0.72$, $r_{GDP,\ AWAS} = 0.82$.

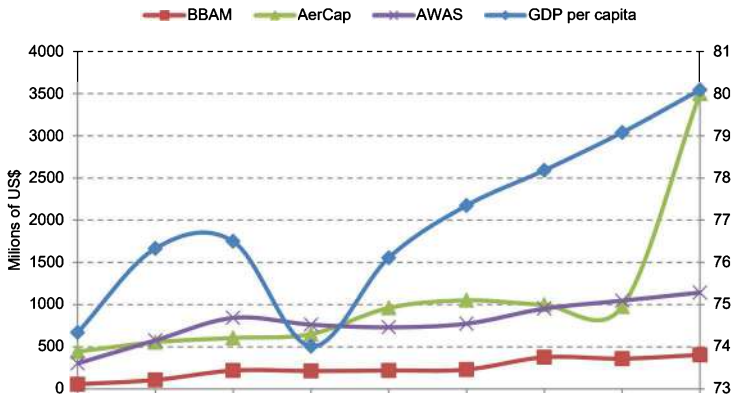


Figure 1: GDP per capita and lease rentals by leasing companies BBAM, AerCap and AWAS
(GDP data source: http://knoema.com/mhrzolg/gdp-statistics-from-the-world-bank?country=Europe%20%26%20Central%20Asia%20(all%20income%20levels); lease rental data source: Annual reports 2006-2014)

It should be noted that the global economic downturn characterized by the lowest value of GDP per capita in the year 2009 is not accordingly followed by lease rentals (Figure 1). This exception can be explained by the fact that aircraft lease is a preferable option for airlines in downturns of the economy (Vasigh et al., 2012) because it enables desirable flexibility. It is worth noting that lessors belong among the airline industry sector which achieved returns above the cost of capital, and they take the second place (after Computers Reservation Systems – CRS) when it comes to return of invested capital (Pearce, 2012). Also, more developed countries with higher value of GDP usually have better credit rating, which enables airlines from these countries to obtain favourable credits for buying aircraft.

3.1. Fleet ownership structure depending on airline business model

This sub-section analyses ownership structure of airline fleet depending on airline business model and geographic distribution. With regard to airline business models, as it is noted above, we analysed full service and low-cost airlines. With regards to geographic distribution, we examined European as well as North American airlines. The analysis is performed as follows.

Considering European full service airlines (35 airlines), it can be noted that airlines have different fleet sizes. In order to analyse airline fleet ownership structure, airlines were divided according to total fleet size into three categories: large (more than 100 aircraft), medium (from 50 to 99 aircraft) and small (less than 50 aircraft).

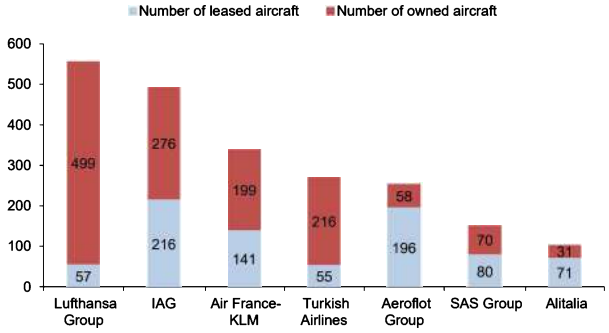


Figure 2: Fleet ownership structure: large European full service airlines
(Data source: https://www.planespotters.net/airlines)

It was determined that large airlines (seven airlines) had a smaller percentage of leased aircraft (Figure 2). The exception, i.e. large percentage of leased aircraft (77%) in the case of the Russian airline Aeroflot group, can be explained by the political situation in Russia. Namely, taxes for owning an aircraft of non-Russian production are very high. In order to avoid this payment, Aeroflot group founded a leasing company in Bermuda. This group bought and registered aircraft in Bermuda, and then, leased aircraft by itself. Alitalia is the airline with the smallest number of aircraft among these seven airlines (Figure 2) and the credit rating in Italy, according to Trading Economics, is recognized as lower medium grade, which could explain the large percentage of leased aircraft (70%). The smallest percentage of leased aircraft can be seen in the case of Lufthansa Group (10%), and it represents the policy of the Group. The total fleet of large European airlines consists of 2165 aircraft, and 38% of them are leased (on average, 45% of the fleet per airline is leased).

Among 35 European full service airlines, there are only four medium size airlines. The percentage of leased aircraft in their fleets varies from 39% to 78%. The total fleet of medium European airlines comprises of 235 aircraft, and 62% of them are leased (on average, 62% of the fleet per airline is leased).

Within small European airlines (24 airlines), as shown in Figure 3, the share of leased aircraft in total fleet is wide-ranging, from 0% to 100%. Three airlines have completely leased fleets, but there are also two airlines with completely owned fleets. Whereas Ural and Nordwind Airlines are Russian airlines, the fleets of which consist of aircraft produced by Airbus and Boeing, it is not unexpected that whole fleets are leased (the reason is the political situation, as in the case of Aeroflot). Air Malta is an airline registered in the country with lower medium grade credit rating (Trading Economics), which could be used as an explanation. The reason why TAROM has no leased aircraft in its fleet could be the majority ownership by the state. Luxair, on the other hand, is an airline from the country with a stable economy and prime credit rating (Trading Economics), hence it could afford to buy an aircraft. Total fleet of small European airlines includes 627 aircraft, and 59% of them are leased (on average, 61% of the fleet per airline is leased).

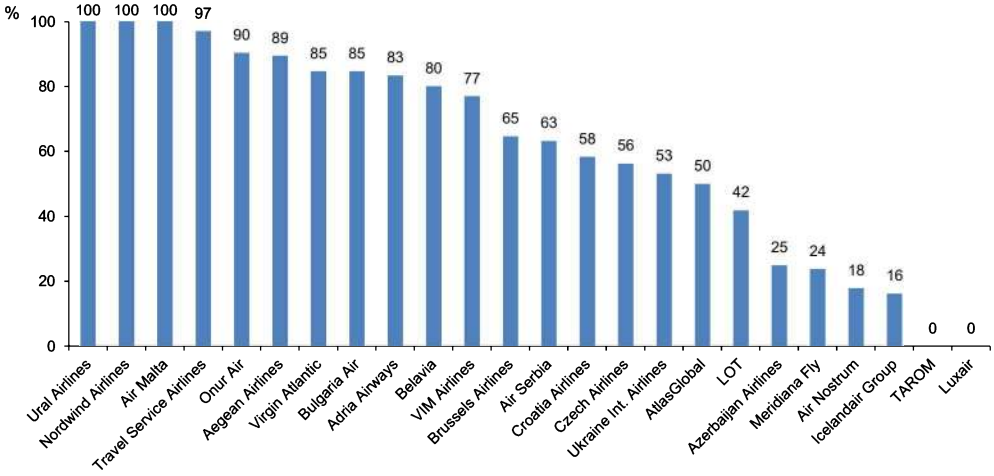


Figure 3: Percentage of leased aircraft in fleets: small European full service airlines
(Data source: https://www.planespotters.net/airlines)

Upon summarizing all leading European airlines (including small, medium and large airlines) considered in this analysis, it has been calculated that the percentage of leased aircraft ranges from 0% to 100%. Their fleets consist of 3027 aircraft in total, and 44% of them are leased (58% per airline on average).

In the case of the seven leading North American full service airlines, certain regularities can be observed. Actually, large airlines (five airlines), lease less than half of their fleet (Table 1). Total fleet comprises of 2814 aircraft, and 25% of them are leased (on average, 25% of the fleet per airline is leased). The remaining two airlines have different fleet sizes (one medium and one small fleet) and different percentages of leased aircraft in their fleets, as well.

Table 1: Fleet ownership structure – North American full service airlines

Airlines	Number of aircraft in the fleet	Number of leased aircraft	Percent of leased aircraft
American Airlines	944	397	42
Delta Air Lines	823	97	12
United Airlines	720	110	15
Air Canada	164	77	47
Alaska Airlines	163	13	8
Aeroméxico	63	45	71
Hawaiian Airlines	48	16	33

(Data source: https://www.planespotters.net/airlines)

The leading full service airlines in the world, as shown in Figure 4, own more than a half of their fleets. Hence, we can agree that these airlines do not favour leasing as an aircraft financing option. Each of these airlines (19 airlines, from different regions in the world) has a large fleet consisting of more than 100 aircraft. Their percentages of leased aircraft range from 3% (All Nippon Airlines - ANA) to 47% (Air Canada). Their fleets consist of 7137 aircraft in total, and 26% of them are leased (26% per airline on average).

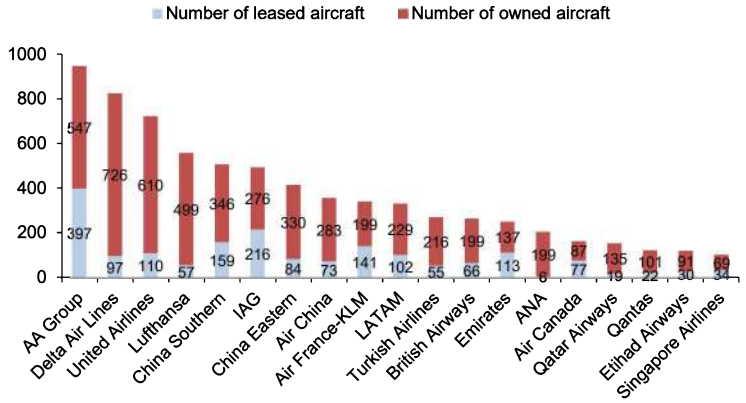


Figure 4: Fleet ownership structure: the world's leading full service airlines
(Data source: https://www.planespotters.net/airlines)

In the case of the 13 European low cost airlines (Figure 5), we can observe three large airlines. Two of them (Ryanair and EasyJet) have small percentages of leased aircraft (similar to any large airline), while this percentage in Vueling is high. This "irregularity" could be explained by the credit rating of the originating country. According to Trading Economics, the United Kingdom has the prime credit rating and Ireland has upper medium grade credit rating, which enables Ryanair and EasyJet to buy aircraft. Spain is ranked as a country with the lower medium grade credit rating, which therefore resulted in favouring lease options over buying (Vueling). Total fleet of the large low-cost airlines includes 661 aircraft, and 28% of them are leased (on average, 42% of the fleet per airline is leased). Percentages of leased aircraft in the six medium size European low-cost airlines vary from 18% to 98%. Their fleets consist of 395 aircraft in total, and 47% of them are leased (on average, 45% of the fleet per airline is leased). Small European low cost airlines lease large percentages of aircraft. Eurowings, an airline fully owned by Lufthansa, is an exception, which is expected because it is Lufthansa's policy is to buy aircraft. Their fleets include 7137 aircraft in total, and 67% of them are leased (on average, 68% of the fleet per airline is leased).

Percentage of leased aircraft in the European low-cost airlines, including small, medium and large low-cost airlines, ranges from 13% to 100%. Their fleets consist of 1156 aircraft in total, and 38% of them are leased (51% per airline on average).

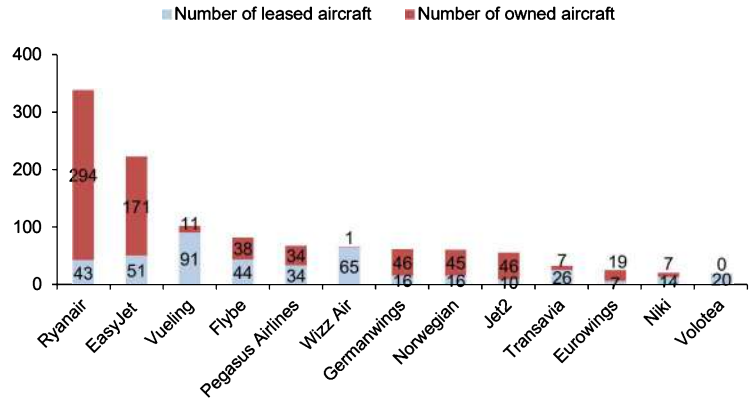


Figure 5: Fleet ownership structure: leading European low-cost airlines
(Data source: https://www.planespotters.net/airlines)

With regard to share of leased aircraft in the total fleet of low-cost carriers in North America, it is observed that large airlines have smaller percentages of leased aircraft and vice versa, small airlines have larger shares of leased aircraft (Table 2). The three large low-cost airlines have a total fleet of 1051 aircraft and 17% are leased (24% per airline on average). The six medium low-cost airlines have a fleet consisting of 403 aircraft in total and 61% are leased (on average, 64% per airline). The total fleet of the ten low-cost airlines consist of 1495 aircraft, 30% of which are leased (on average, 51% per airline).

Table 2: Fleet ownership structure – North American low cost airlines

Airlines	Number of aircraft in the fleet	Number of leased aircraft	Percent of leased aircraft
Southwest Airlines	716	86	12
JetBlue	217	54	25
WestJet	118	40	34
Allegiant Air	86	4	5
Spirit Airlines	80	57	71
Virgin America	60	50	83
Volaris	59	55	93
Frontier Airlines	59	54	92
Interjet	59	25	42
Air Canada rouge	41	22	54

(Data source: https://www.planespotters.net/airlines)

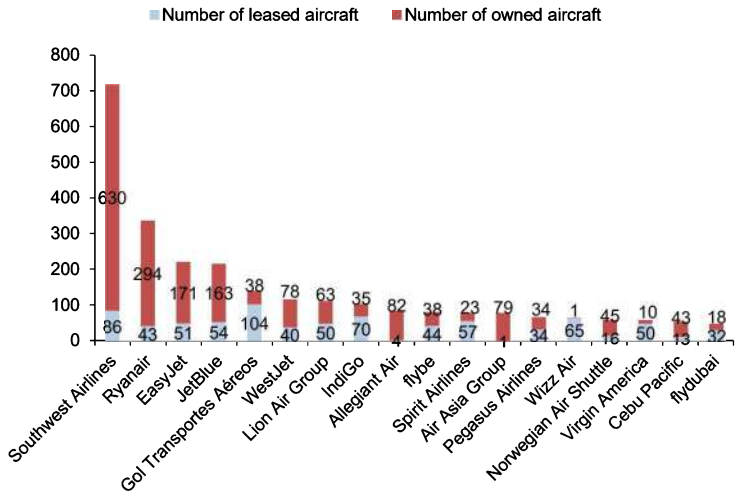


Figure 6: Fleet ownership structure: world's leading low-cost airlines
(*Data source:* https://www.planespotters.net/airlines)

We can distinguish between eight large and ten medium low-cost airlines among the leading low-cost airlines in the world, as shown in Figure 6. Percentage of leased aircraft in large airlines ranges from 12% to 73%. Their fleets consist of 1970 aircraft in total, and 25% of them are leased (on average 36% per airline). The percentage of leased aircraft in medium airlines ranges from 1% to 98%. Total fleet of medium airlines encompasses 689 aircraft and 46% of them are leased (in average per airline 48%). Bearing in mind the analysis performed, it can be noted that an airline's business model does not play a significant role in the fleet ownership structure. Both full service and low-cost airlines have similar percentages of leased fleet, which mostly depend on fleet size.

With regard to geographic distribution of airlines and all the above, slight differences between European and North American airlines can be observed. The European airlines prefer to lease aircraft more than the North American ones. In the European full service airlines' fleet, 44% of aircraft are leased compared to 26% in North American fleet, while in the European low-cost airlines' fleet 38% of aircraft are leased compared to 30% in the North American ones.

3.2. Fleet ownership structure depending on alliance membership

Whereas airlines tend to join some of the global alliances, it is interesting to analyse fleet ownership structure of airlines that are members of alliances. Star Alliance, SkyTeam and OneWorld are the largest alliances; therefore, we studied fleet ownership structure of their members.

Star alliance has 27 member airlines. The alliance's fleet comprises of 3589 aircraft in total, and 28% of the fleet is leased. Large member airlines (11 airlines) have a smaller percentage of leased aircraft (27% on average). The exception is Avianca, the Colombian national airline (60% of the fleet is leased). It could be explained by the credit rating of this country (lower medium grade). When it comes to airlines with medium size fleets (11 airlines), ownership structure is diverse. Small airlines' fleets (5 airlines) have larger percentages of leased aircraft in their fleets than the airlines with large fleets. Ownership structure of the Star Alliance member airlines fits very well with the pattern of fleet ownership structure observed in the case of European and North American airlines, as previously described. SkyTeam alliance has 18 member airlines. The alliance's fleet comprises of 2932 aircraft in total, and 36% of the fleet are leased. It is worth noting that ownership structure of these airlines does not fit well the previously described pattern of fleet ownership structure. There are three exceptions among nine airlines with a large fleet (Aeroflot, Garuda Indonesia and Alitalia). Oneworld alliance has 14 member airlines. The alliance's fleet comprises of 2575 aircraft in total, and 38% of the fleet are leased. Out of eight large member airlines, Airberlin is the one that does not fit the observed pattern.

It is worth noting that none of the airlines which are members of an alliance has a completely leased fleet. The maximum percentage of leased aircraft in their fleets is 90%. Also, it can be observed that the membership in an alliance does not affect the fleet ownership structure.

3.3. Fleet ownership structure

Apart from the analysis presented in the previous sub-sections, we extended the list of analysed airlines to airlines operating on the domestic market (Nikola Tesla Airport, Belgrade), as well as to additional leading airlines in the world (132 airlines in total). The set of 132 airlines encompasses all airlines, irrespective of their business models. In this set of airlines there are 43 large (Table 3), 37 medium, and 52 small airlines (Table 3). Summarizing all data, we established that 77% (33 airlines) of large airlines leased less than a half of the fleets; 51% (19 airlines) of medium and 69% (35 airlines) of small airlines leased more than a half of their fleets.

Table 3: Ownership structure – key indicators

Airlines' size	Number of airlines	Total number of aircraft	Total number of leased aircraft	Total percentage of leased aircraft	Average percentage of leased aircraft
Large	43	11603	3484	30	36
Medium-large	15	1244	454	36	37
Medium-small	22	1295	754	58	58
Small	52	1240	770	62	63

(Data source: https://www.planespotters.net/airlines)

Considering the set of medium size airlines, it was noticed that by dividing medium airlines into two sub-sets, medium-large (from 75 to 99 aircraft in the fleet, 15 airlines) and medium-small (from 50 to 74 aircraft in the fleet, 22 airlines), certain similarities with the small and large airlines could be observed (Table 3). Namely,

medium-large airlines have indicators similar to large airlines' indicators and they have smaller percentages of leased aircraft in their fleets, while medium-small have indicators similar to small airlines' indicators and they have larger percentages of leased aircraft in their fleets. Taking into consideration these similarities, we calculated the key indicators for large, medium-large, medium-small and small airlines (Table 3). Table 3 shows that the average percentage, as well as total percentage of leased aircraft, increases with the decrease in fleet size, thus supporting our findings from the previous sub-sections.

4. CONCLUSION

Having in mind that airline industry is highly dependent on economic cycles and that airline market is price- and time-sensitive, it is obvious that airlines need to react to market condition changes in a timely manner. The ability of an airline to respond in an appropriate way to these changes could be provided by fleet flexibility, which could be further provided by aircraft leases.

Based on the analysis of airlines from different countries and with different business models, the conclusions we arrived at are as follows:

- Airline's business model does not affect fleet ownership structure significantly;
- European airlines slightly prefer to lease aircraft compared to North American airlines;
- Small number of aircraft in an airline fleet (less than 50) implies higher percentage of leased aircraft (more than 50% of the fleet is leased);
- Larger number of aircraft in an airline fleet (more than 100) implies smaller percentage of leased aircraft (on average, approximately one third of the fleet is leased);
- Membership in an alliance does not affect fleet ownership structure; member airlines fit very well in the observed pattern of fleet ownership structure;
- Average and total percentages of leased aircraft increase with the decrease of fleet size.

The paper results in practical contributions, providing an ownership structure analysis and summarizing all data related to previous experiences of different airlines which could help an airline when considering whether to lease or buy an aircraft. Furthermore, the analysis could help not only airlines, but leasing companies as well, to define a target group of airlines to whom they could lease corresponding aircraft in appropriate time.

AKNOWLEDGEMNT

This research has been supported by the Ministry of Education, Science and Technological Development, Republic of Serbia, as part of the project TR36033 (2011-2016).

REFERENCES

Airline fleets. (2016). Airline index. Retrieved from https://www.planespotters.net.

Bazargan, M., & Hartman, J. (2012). Aircraft replacement strategy: Model and analysis. *Journal of Air Transport Management,* 25, 26-29. doi:j.jairtraman.2012.05.001.

GDP Statistics from the World Bank. (2016). Retrieved from http://knoema.com.

Gibson, W., & Morrell, P. (2004). Theory and practice in aircraft financial evaluation. *Journal of Air Transport Management,* 10, 427-433. doi:j.jairtraman.2004.07.002.

Holloway, S. (2008). *Straight and Level: Practical Airline Economics* (3rd ed.). Ashgate Publishing Limited, England, Ashgate Publishing Company, USA.

Hsu, C.I., Li, H.C., Liu, S.M., & Chao, C.C. (2011). Aircraft replacement scheduling: A dynamic programming Approach. *Transportation Research Part E,* 47, 41-60. doi.10.1016/j.tre.2010.07.006.

IATA. (2015). IATA Air Passenger Forecast Shows Dip in Long-Term Demand. Retrieved from http://www.iata.org.

ICAO. (2004). doc. 9626, Manual on the Regulation of International Air Transport.

Mancilla, D.O. (2010). Aircraft Asset Management: Tools & airline strategies during a world market downturn. *14th Annual World Conference Air Transport Research Society*, Porto, Portugal.

Morrell, P. (2013). *Airline Finance* (4th ed.). Farnham, Surrey, England: Ashgate Publishing Limited and Burlington, USA: Ashgate Publishing Company.

Oum, T.H., Zhang, A., & Zhang, Y. (2000). Optimal demand for operating lease of aircraft. *Transportation Research Part B: Methodological,* 34(1), 17-29.

Pearce, B. (2012). The state of air transport markets and the airline industry after the great recession. *Journal of Air Transport Management,* 21, 3-9. doi:10.1016/j.jairtraman.2011.12.011.

The World Bank. (2016). Data. Retrieved from http://data.worldbank.org.

Trading Economics. (2016). Credit Rating. Retrieved from http://www.tradingeconomics.com.
Vargas, L.G., & Saaty, T.L. (1981). Financial and Intangible Factors in Fleet Lease or Buy Decision. *Industrial Marketing Mnagemant,* 10, 1-10.
Vasigh, B., Taleghani, R., & Jenkins, D. (2012). *Aircraft Finance: Strategies for Managing Capital Costs in Turbulent Industry*. Fort Lauderdale, USA: J. Ross Publishing.

KNOWLEDGE MANAGEMENT **864**

TRANSNATIONAL R&D COOPERATION AND BARRIERS TO COOPERATION IN THE DANUBE REGION – SERBIA CASE **865**
Semenčenko Dušica, Živković Lazar, Kutlača Đuro

COMPETENCY OF REGISTERED FARMERS FOR INDEPENDENT BUSINESS **873**
Miladinović Slobodan, Ljiljanić Nikola

KNOWLEDGE MANAGEMENT

TRANSNATIONAL R&D COOPERATION AND BARRIERS TO COOPERATION IN THE DANUBE REGION – SERBIA CASE

Dušica Semenčenko*[1], Lazar živković[1], Đuro Kutlača[1]
[1]Institute Mihajlo Pupin, Belgrade University
*Corresponding author, e-mail: dusica.semencenko@pupin.rs

Abstract: *Transnational R&D cooperation is becoming an increasingly important factor in improving cohesion and for increasing the competitiveness of countries through cooperation. Globalization of research activities has contributed to the increase in endeavors in exploring international scientific and technological cooperation. The aim at this paper is to review the current situation of international cooperation in the Danube region with regard to co-publication analysis and to introduce barriers that influence transnational R&D cooperation with a special focus on Serbia. The main results conducted under the research project Danube-INCO. NET are presented.*

Keywords*: R&D, barriers, international RTDI cooperation, danube region*

1. INTRODUCTION

Some previous results, of analysis of the national innovation system (NIS) in Serbia, given by Kutlača and Semenčenko (2015), shown that cooperation, on the different levels of the NIS, is one of the crucial problems of system's functionality. Although, international cooperation was always seen as a more preferable than cooperation within the system, in particular, between its parts - science and research (S&R) sector and business sectors, as it was stated in Semenčenko (2009) and Semenčenko et al (2013).

International research and development (R&D) cooperation is quite demanding, objectively as well as subjectively. This is not only regarding inner capacities of the R&D but also concerning certain R&D programs ' rules, the geopolitical affiliation with the country e.g., which are changing into the time , however in the particular period constitute meaningful obstacles . Having in mind trends in regional clustering of European countries, Serbia is mostly connecting with West Balkan and South East European countries, but through the long period of time, and geographically and historically, more logical affiliation is within the Danube Region, which is also confirmed with the latest European Union's strategy for the Danube region (EUSDR) (2010, 2013).

The Danube region is characterized by much diversity: starting with the countries' level of economic development and political status regarding EU, up to the often different and contradictory observations of the region in the context of research and development systems' excellence and cohesion. The aim at research which we are calling upon in this paper was to clarify the relationship between scientists and researchers from the Danube region towards cooperation in one hand, and barriers and various concepts of scientific and innovation work in the other hand, regarding their R&D cooperation inside the region. Therefore, the territorial limitation could be one of the consequences although, as it was shown, chosen indicators were fairly enough for making a picture of the current situation of international cooperation in the region. Therefore, the territorial limitation could be one of the consequences but, as it was shown, chosen indicators was fairly enough for making a picture of the current situation of international cooperation in the region, as well as barriers which make obstacles in stronger cooperation achievements. Our analysis is grounded on researches done in the frame of the FP7 project Danube-Inco.net, where authors have been team members.

Specific attention will be devoted to these subjects' features of Serbian R&D system.

The project Danube-Inco.net is gathering researchers from 19 partner organizations, belonging to 14 DR countries. One of the preconditions for the region definition is classification of countries/regions of the Danube region, according to geopolitical affiliation: EU member states (MS) and regions upstream of the Danube: Austria, Croatia, Czech Republic, Hungary, Slovakia, Slovenia, Germany – in particular Baden-Württemberg and Bavaria; EU MS and regions downstream of the Danube: Bulgaria, Romania; Enlargement countries: Bosnia and Herzegovina, Montenegro, Serbia; Neighborhood countries: Moldova and Ukraine (in particular oblast Odessa, Uschhorod, Ivano-Frankowsk and Czernowitz).

In general, two types of analysis have been done, first one regarding cooperation barriers in the Danube Region and the second one within activities regarding monitoring of research and innovation cooperation. In the frame of the project, authors of this paper particularly were working on the analyses of barriers to cooperation in R&D cooperation in DR.

The first type of study supposed to increase awareness of the presence of barriers to cooperation and to offer recommendations for overcoming of such kind of obstacles. In this way, stakeholders will be able to better understand potential omissions in cooperation and communication, including social and cultural aspects of them. Somewise similar survey was conducted in 2008 in the frame of project WBC-Inco.Net, where have been identified differences in barriers perception of R&D projects cooperation among Western Balkan countries and EU member countries, results of which are presented in Švarc, J. et al (2009).

The second type of studies was focused on identification of synergies, initiatives for joint activities improvement. This study scrutinizes both the co-publications and the co-patents in Danube Region Countries (DRC) and the Western Balkan countries (WBC) for the years of 2003-2013, and cooperation in projects also. Each analysis has its distinct methodology and yields specific results which are shortly presented below.

2. SCIENCE AND RESEARCH COOPERATION IN THE DANUBE REGION

2.1 Co-publication analysis

As already indicated above, the Danube Region is a very diverse geographical area, especially in terms of national research and innovation systems, ranging from highly developed countries like Germany or Austria to less developed ones like Moldova. The following circumstances should be taken into account, when looking at the numbers of publications, since a less developed country usually also spends smaller money on its RTDI system, hence affecting herewith also the publication output of its scientific/academic institutions. In general, the share of internationally co-authored publications is between 40-50%. Further, the general estimation that smaller research communities are, due to limited national capacities, better internationally connected seems to be valid. One of the first research in international cooperation as co-authorship did by Frame and Carpenter (1979) resulted in three main rules: 1. international cooperation has a higher intensity in basic research, 2. the bigger national research system – less international cooperation in co-publication, 3. the external factors play the major role in international cooperation. As Glänzel and Schubert (2005) point out, this “international ambition” in producing publications has another positive consequence: International co-publications are more likely to appear in high-impact journals and have a better chance to be cited, than “domestically” produced papers. Austria, for example, has one of the highest shares of internationally co-authored publications. We registered fewer international co-publications for Croatia (26%), Romania (26%), Serbia (31%), Czech Republic (33%), and Ukraine (34%).

The analysis of the publication data was carried out along several dimensions (data is available in the study Lampert, D. et al (2015)): overall co-publication output numbers per country to provide an overview, the internationalization of publications, the strongest co-publication links among the countries under scrutiny, main scientific research fields, and some highlights regarding scientific impact.

The methodology of the co-publication analysis was based on the two main academic citation databases, namely Web of Science and Scopus. By unification of data onto these two databases was achieved high quantity of 25% higher publication coverage, and quality because each data source can be taken as a quality check for the other or as an additional source for missing information.

The study analyzes all publications of both databases that featured any affiliation with one of the countries of the Danube Region in order to be able to draw conclusions of the differences between “all publications” and the “co-publications”. Regarding document types, scientific articles are taken into account in the same way as conference proceedings, academic letters, and other document types that were tracked by the both data sources. The reason for this procedure is the idea that jointly published conference papers can indicate international cooperation activity, which is of prime interest in the Danube-INCO.NET project. The data are available only with partly different field names and different quality (depending on the data source).

Over 1 million records were analyzed and almost each has, on average, been authored by 7 researchers affiliated with 1.8 countries and been cited about 6.5 times. Of those overall publications, around 394,000 are Danube Region co-publications, each involving at least one DRC and one other country outside the DR in

the period between 2003 and 2013. Each of those co-publications has, on average, be authored by about 13 researchers affiliated to 3 countries and been cited 11.87 times. Output patterns suggest the following three country groupings: Austria, Czech Republic, Romania, Hungary, and Ukraine (between 8,000 and 25,000 publications per year); Serbia, Croatia, Slovenia, Slovakia, Bulgaria (between 1,000 and 8,000 publications per year); Bosnia and Herzegovina, FYROM, Albania, Moldova, Montenegro, and Kosovo* (between 40 and 1,000 publications per year).

In addition to the absolute number of DR publications, the growth rate of production of their publication of the reporting period of eleven years is obvious. Among all DRC, Romania and Serbia have expressed particularly high growth in their production of publications.

2.2 Scientific research fields in Serbia's (co-)publications

As it could be found in the analysis presented in Lampert, D. et al (2015), "Serbia's specialization in the area of Clinical Medicine is clearly visible but does not translate into the situation in Serbia's co-publications - whereas the share of Clinical Medicine co-publications in Serbia's overall international co-publications is 22.89%, the share of Clinical Medicine in Serbia's publications is 29.11%." Clinical Medicine is followed by Physics & Astronomy (10.43%) with even a higher share for Serbia's co-publications (17.50%) and Danube Region co-publications (18.74%). Science Metrix fields in Serbia's publication and co-publication are shown as a whole in the table 1.

Table 1: Science Metrix fields in Serbia's (co-)publications, 2003-2013 (Source: Danube-Inco.net project D.4.16, according to WoS+Scopus)

Science Metrix fields (most important)	RS overall publications	Share	RS co-publications	Share	RS-Danube Region co-publications	Share
Agriculture, Fisheries & Forestry	1,833	**3.59%**	502	**3.27%**	311	**4.14%**
Biology	2,688	**5.27%**	865	**5.63%**	503	**6.69%**
Biomedical Research	2,177	4.26%	709	4.62%	333	4.43%
Chemistry	4,239	**8.30%**	1,298	**8.46%**	671	**8.92%**
Clinical Medicine	14,858	**29.11%**	3,514	**22.89%**	1,792	**23.83%**
Earth & Environmental Sciences	943	**1.85%**	320	**2.08%**	185	**2.46%**
Economics & Business	708	1.39%	169	1.10%	82	1.09%
Enabling & Strategic Technologies	4,085	**8.00%**	1,344	**8.76%**	642	**8.54%**
Engineering	3,847	7.54%	958	6.24%	528	7.02%
Historical Studies	338	0.66%	121	0.79%	77	1.02%
Information & Communication Technologies	3,979	7.79%	941	6.13%	366	4.87%
Mathematics & Statistics	2,715	**5.32%**	1,166	**7.60%**	263	**3.50%**
Physics & Astronomy	5,324	**10.43%**	2,687	**17.50%**	1,409	**18.74%**
Social Sciences	1,334	2.61%	238	1.55%	141	1.88%

According to the above mentioned study Lampert, D. et al (2015), in Serbia's DR co-publications, strong growth (more than 800% growth rate) is visible from Agriculture, Fisheries & Forestry, Biology, Biomedical Research, Clinical Medicine, Enabling & Strategic Technologies, Engineering, and ICT. Contrary to Romania, there is a rather strong growth visible from Physics & Astronomy as well, from 34 Serbian DR co-publications in 2003 to 288 Danube Region co-publications in 2013. Compared to the growth rate of the above-mentioned fields with strong growth, this is not as much, but nevertheless, the yearly co-publication output is more than six times as high as in 2003. But, Physics & Astronomy, like for Romania, is at least not the main driver behind the output growth of Serbia. Compared to the average times cited counts in the Danube Region collaboration output, the strengths of Serbia are in physics & astronomy.

2.3 Overview of research and innovation projects in the region

The main objective of this activity was to identify and analyze the project results in the field of cluster development, technology transfer and other innovation support measures that have a transferability potential for the Danube Region. The activity is not focused on analysis of research cooperation in the region as such but rather on selection of most relevant success stories (results of the EU-funded projects implemented during 2007-2013) that have significant relevance and potential for transferring the know-how, methods, schemes and tools to the Danube Region in implementation of research and innovation strategies and targets set on the macro-regional level.

The results of analysis (for more details Filus, I., et al (2015)) are targeted to national or regional administration and policy makers, future programs participants, relevant stakeholders and members of the EUSDR Priority Areas or respective parties involved in planning and implementation of the funding programs (e.g. DRRIF) for sectorial replication, implementation of proven tools, making synergies and creating further added value based on already available resources. The presence of such tools in the EU and/or Danube Region creates a potential for transfer of the success stories in the region, mutual learning, building the synergies and possible development of common mechanisms for the region. The analysis might be also used as a knowledge base and inspiration for the other macro-regions, for authorities on regional and local level or for the development of the R&I support actions.

According to this analysis, 75 projects were gathering partners from DRC as it is shown in Table 2.

Table 2: Number of analyzed projects per area (Source Danube-Inco.net project D.4.15)

AREA / PROJECT	SEE	CE	FP7	CIP	TOTAL
Cluster development	4	9	20	1	**34**
Technology transfer	15	14	26	4	**59**
Financing tools	3	3	3	0	**9**
Non-financing tools	12	15	13	3	**42**
TOTAL PROJECTS	**18**	**21**	**32**	**4**	**75**
TOTAL RESULTS	**46**	**92**	**130**	**6**	**274**

Serbia was a partner with other DRC in 13 different projects out of 75: AUTOCLUSTERS (SEE), CAPINFOOD (SEE), ClusterPoliSEE (SEE), EVAL-INNO (SEE), FORSEE (SEE), I3E (SEE), INTERVALUE (SEE), IPRforSEE (SEE), ISEDE-NET (SEE), SEE-IFA Network (SEE), TECH.FOOD (SEE), BALCON (FP7), Enterprise Europe Network (CIP).

3. BARRIERS TO R&D COOPERATION FOR SERBIAN R&D COMMUNITY

3.1 Perception of barriers

Data collection method, which has been used by authors of this paper, in the study about R&D barriers, was a web-based questionnaire. The questionnaire was delivered to the respondents through the dissemination of information about the survey (with the link to the questionnaire). The questionnaire was mainly addressed to the wider science, research & innovation community from all Danube Region countries. At the end of the process, 1590 answers to the questionnaire were received. More details of methodology are available in Kutlača, Đ. at al (2015). A sample of respondents from Serbia included 425 respondents of different ages, research areas, and work experience. The highest percentage of respondents in the sample was between 41-50 years old, while over 75% was between 31-60 years old, 56% of them had a minimum 10 years of work experience.

The survey consisted of 5 main parts and 22 questions in total: general data, general data on international cooperation, priorities in selecting the country of cooperation, barriers to cooperation, and recommendations. Statistical analysis is conducted using Statistical Package for the Social Sciences (SPSS). The following statistical methods were applied: descriptive analysis, t-test for equality of means, chi-square test, one-way and two ways ANOVA, factor analysis. The first level of the analysis was descriptive statistics of general data which enabled an overview of the socio-demographic characteristics of respondents, general information about the cooperation, and priorities of respondents in selecting the country for cooperation.

The following figure 1 shows experience of respondents from Serbia in cooperation with the Danube region countries in all research programs measured on the Likert scale from 1 to 5, in the last seven years. Among four types of cooperation, partnership in RTDI projects inside the region exists on the highest percentage. Although the sample of respondents consists mainly of experienced researchers, it can be concluded that the experience in international RTDI projects is not high. If we limit RTDI projects only on the Danube Region and 14 countries in the Danube region, only 37% of Serbian respondents participated in the international cooperation with these countries. On the level of the whole DRC sample, the highest differences are perceived regarding participation in international collaborative RTDI projects inside the region, where EU MS and regions upstream of the Danube have the most respondents with positive answers – 72.22% while only 37.39% of participants from Enlargement countries have been involved in such projects. Respondents from Enlargement countries also have the smallest percent of visits to the Danube region countries for RTDI cooperation - just 38.03% (in Serbia only 36%) of respondents had that kind of visits in the last 7 years. EU MS and regions upstream of the Danube and Neighborhood countries have a higher score – more than 57 %.

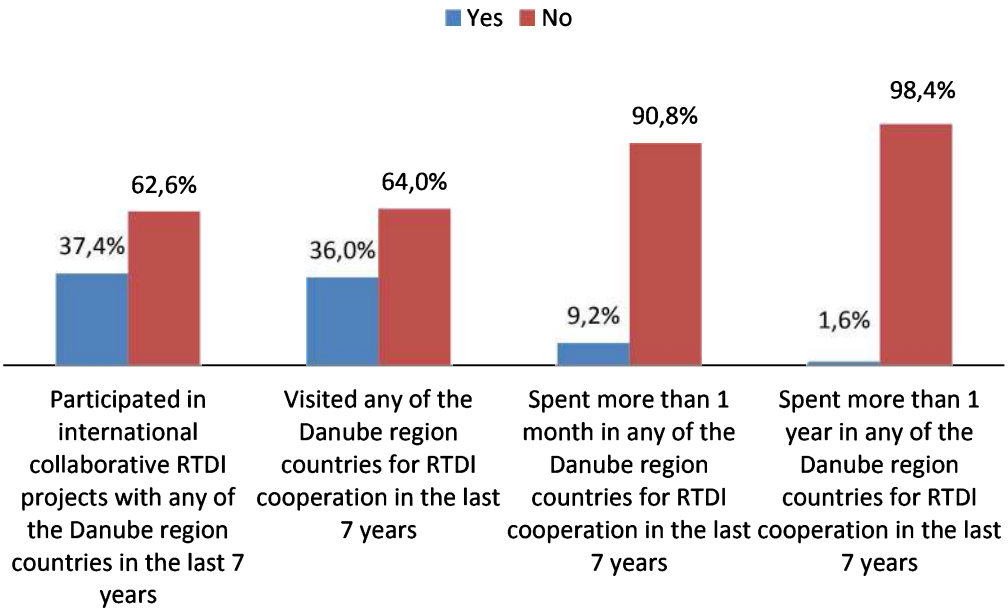


Figure 1: Experience of respondents in cooperation with the Danube region countries

Respondents from EU MS and regions upstream of the Danube have also significant results when it comes to the living in DR countries with the purpose of RTDI cooperation – 12.78% of them have spent more than 1 month in some of the DR countries, while 5% have spent more than 1 year in some of these countries. EU MS and regions downstream of the Danube have low share in visits to DR countries which last more than 1 month, but a very high share of visits that last more than 1 year (9.52%). In Enlargement and Neighborhood countries the situation is quite opposite – the share of shorter stays in DR countries is much higher than the share of longer stays in these countries.

In addition to descriptive statistics and basic data on the perception of barriers in the Danube region, particular attention was given to the perception of barriers according to demographic characteristics of respondents, in that way we have defined 5 working hypothesis.

Hypothesis 1: Older researchers (minimum 10 years of working experience) have a lower perception of barriers in international R&D cooperation in comparison with younger researchers (less than 10 years of working experience). Using T-test of independent samples, medium values of barriers in R&D cooperation between older and younger researchers were compared. According to results, it could be concluded that there are no significant differences in barriers perception of less experienced and more experienced researchers. Hypothesis 1 was not justified.

Hypothesis 2: The age of researchers influenced barriers in R&D cooperation perception. Results of one-way ANOVA analysis shown, that there is no differences in perception of barriers, according to the age of respondents. Although there was an assumption that researchers at the beginning of their careers will have more obstacles to cooperation, this difference was not statistically significant.

Regarding gender ratios to this sample were prevailed women, thus, 53% of respondents were women, and 47% men.

Hypothesis 3: In the perception of R&D barriers in international cooperation there are differences between female and male. A t-test of independent samples was used for the variable "gender" since in this variable is only two answer groups. There is a significant difference between male and female with regard to the perception of administrative and personal barriers.

Barrier perception mean values of the Likert scale of 1 to 5 indicate that women have statistically significant difficulties in international cooperation when it comes to problems with projects application, then the process of project implementation and reporting. Furthermore, personal factors, such as gender, family situation, the preferred career, are significant barriers more for women than for men.

The vast majority of respondents in the sample came from the high education sector (70%), followed by public sector (mostly public institutes) 25%, and only 4% was from the business sector. Relatively a small number of respondents from business sectors are a limitation of the analysis due to the inability of overview the whole R&D sector in Serbia. All in all, the sample corresponded most to the structure of human resources in the R&D system in Serbia (based on the statistical data of the Statistics Office of the Republic of Serbia), and the results can be considered adequate for making conclusions and recommendations.

Hypothesis 4: researchers from the different types of institutions have the different perception of barriers in international R&D cooperation. Using one-way ANOVA analyses of variances mean values of barriers in international R&D cooperation of respondents from all three sectors had been compared. According to the results, we can conclude that there is the significant difference in perception of institutional barriers among respondents. Researchers from faculties have statistically significant barriers in international R&D cooperation in comparison with researchers that are working with public institutes.

The vast majority of respondents are in engineering sciences (29%), following with natural sciences and social sciences with percentage respectively 21% and 17%. The category "other", covers 4% of the sample of respondents that are not directly from R&D sector, they are rather stakeholders from the business sector and public administration.

Hypothesis 5: There is a difference in perception of barriers in R&D cooperation among researchers from different scientific fields. Hypothesis testing showed that there are no significant differences in barrier perception of researchers from different science fields. Hypothesis 5 has not been justified.

3.2 Defining activities for overcoming barriers

With the aim to overcome barriers to international R&D cooperation, researchers assessed 15 suggested measures on the Likert scale of significance from 1 to 5. The mean value of activities' significance (with a range from 4.15 to 3.05), shown that researchers consider realization of those activities, as an important step in overcoming the barriers.

The most important activities to the majority of researchers are international conferences attendance and program of mobility - single visits to research organizations of the aim at the joint project proposals preparations. Besides mentioned, very important and necessary activities are those which promote more efficient information canals about potential projects funding, in order to promote international cooperation and increased the number of project applications.

Respondents were given the opportunity to propose measures to overcome barriers in international RTDI programs in reply to an open-ended question. Responses were classified according to the criteria to whom the activities are directly or indirectly related to. According to the level at which the improvement should be implemented, 4 main groups were identified:

- Support from the European Commission (EC) - activities related to project financing, administration and legal framework of projects, better reallocation of funds etc.,

- National support - activities to be undertaken at the state level in order to overcome barriers to international cooperation.
- Institutional supports - activities to be undertaken at the level of institutions
- Objective problems - problems that should be solved by the teams, include personal approach.

Based on defined key stakeholders for activities implementation, according to respondents' answers, it is necessary to undertake concrete measures.

European Commission has to contribute to following:
1. Improving control of project implementation (Allow individual faculties to be independent of the university; Nullify all university regulations specifying that international cooperation must be done at the university level; Preventing of abuse in spending project funds by university management office; Introduce penalties for head/director who abused their position of authority for personal financial gain).
2. Addressing legal and administrative problems (Better harmonization of different programs; Reducing lobbying for other countries in EU administration).
3. Increasing funding opportunities (More calls for small collaborative research projects; More money for infrastructure facilities; More study visits to other countries, and more opportunities for research fellowships).

National support refers to following:
1. Solving legal issues (Adjustment of legal provisions; Harmonization of laws and science programs with EU; Mismatch between international and national law and economy regulations; Improving high education and scientific youth).
2. Financial support (National financial support for strategic international project proposals; Increasing investment in RTDI; More investment in science; More investment in science and RTDI; More investment into institutional capacity building).

Objective problems would be solved in the following way.
1. Improving communication between partners and colleagues (Better communication with colleagues; Better communication and collaboration between scientific institutions in the Danube region; Better overall communication; More individual contacts between experts from the same or similar field of research).

2. Other (Implementing in all research institutions an advisor regarding project preparation and submission; Better distribution of tasks at the university; Proactive approach; Professional help in writing proposals).

4. CONCLUSION AND RECOMMENDATIONS

Since our research shown that the most significant obstacles to the cooperation of researchers from Serbia within the Danube region (and beyond) are those related to the 1. The overall capacity of the country; 2. The administrative and bureaucratic procedures in the application process, implementation, and reporting on the international projects and 3. Socio-political conditions in the country, we will conclude this paper with an attempt to define specific recommendations.

1. Barriers regarding overall capacity of the country are the most important barriers in international RTDI cooperation among the Danube region countries. Strong recommendation to the S&T policy makers in the countries of Danube region is to increase investments in science and technology and particularly increase financial support for international cooperation from public sources.
In addition, Serbian government should harmonize the laws and science programs with EU. Aligning national strategies is a crucial point in order to improve the cooperation in the Danube region.
2. Following the findings based on the analysis of administrative and bureaucratic barriers, recommendations for S&T policy makers not only in Serbia but also in EU countries are:
- to establish efficient processes for programs and projects evaluation.
- to reduce the quantity of projects' documentation.
- to speed-up evaluation procedures and to shorten the time needed for contracts.
- to standardize procedures for project submission and monitoring.
- to secure forehand / on time payment by funding organizations, reducing delays.

3. Socio-political barriers are not so important to the international cooperation at the whole sample of the Danube region countries. As the main obstacle, an inferior position of research and innovation compared to the economic development and political stability was emphasized. Accordingly, it can be concluded that in order to improve international cooperation, the greater concentration of resources on research and development in the Danube region is needed.

If we call upon above mentioned three main rules of international co-publication, in the case of Serbia we can agree with two of them: 1. international cooperation has a higher intensity in basic research 2. the

external factors play the major role in international cooperation. Although Serbia is a small country percentage of co-published papers are under average bellow of DRC, which could be the only result of barriers explained in our analysis. As production of publications is, in general, the outcome of joint projects an additional recommendation to the S&T policy makers in the region is to promote S&T cooperation within the Danube Region in order to increase motivation and interest of the participants for such cooperation.In order to avoid fragmentation of the innovation efforts in the future, we recommend implementing efficient coordination and communication mechanisms between the programs on EU level, e.g. between Framework programs (Horizon 2020, COSME) and trans-regional programs (Central Europe, Danube Region) as well as within these groups. Coordination and synergy building have to be developed also between programs on the EU level and national or regional programs and initiatives (including specific operational programs of the European Structural and Investment Funds).

Socio-political barriers in Serbian international cooperation are primarily caused by its geopolitical status (small, non-EU member country), this is not possible or, it is very challenging to change or overcome. However, expenditure of research and technological development are also limiting factor for Serbian researchers in international cooperation, and recommendations for improving the overall capacity of the state are also very important to be applied in this area.

ACKNOWLEDGEMENT

Research presented in this paper was supported by the Ministry of Education, Science and Technology Development of the Republic of Serbia, under the projects: reg. no. III 47005, and by the FP7 project Danube-Inco.Net.

REFERENCES

European Union Strategy for Danube Region (2010). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Brussels, 08/12/20010 COM(2010) 715. Retrieved from http://www.danube-region.eu/component/edocman/communication-of-the-commission-eusdr-pdf

Filus, I., Vrátny, Š., Kučera J. (2015). Analysis of research and innovation projects in the region and transferability of results. Retrieved from https://danube-inco.net/object/document/15279/attach/D4 15_Analysis_of_research_and_innovation_projects_in_teh_region_and_transferability_of_results_final.pdf

Frame, J. D., Carpenter, M. P. (1979). International research collaboration, Social Studies of Science, 9, 481-497.

Glänzel, W., Schubert, A. (2005). Analyzing scientific networks through co-authorship, in: Handbook of Quantitative Science and Technology Research, (p. 257-276), Springer Netherlands, 265.

Kutlača, Đ., Semenčenko, D., Živković, L., Štrbac, D. (2015). Study on cooperation barriers in the Danube Region, Retrieved from https://danube inco.net/object/document/15392/attach/ Deliverable_4_17_Barriers_to_cooperation_in_the_Danube Region_final.pdf

Kutlača, Đ., Semenčenko, D. (2015). Nacionalni inovacioni sistem u Srbiji: prošlost, sadašnjost, budućnost, Beograd. www.pupin.rs/cirnt/wp-content/uploads/2012/12/NIS2-P1-color.pdf

Lampert, D, Brugner, P., Büsel, K., Dall, E., Degelsegger, A., Piroi, F., Simon, J., Wagner, I., Zupan, I. (2015). Copublication and co-patenting analysis among countries in the Danube Region (Deliverable D4.16) Retrieved from *https://www.zsi.at/object/publication/3743/attach/D4-16_Co publication_and_co-patenting_analysis_among_countries_in_the_Danube_Region_27-04 2015_updated_15-05-2015-1.pdf*

Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Concerning the added value of macro-regional strategies. (2013), Brussels, 27.6.2013 COM(2013) 468 final. Retrieved from http://ec.europa.eu/regional_policy/sources/docoffic/official/communic/baltic/com_added_value_macro_region_strategy_en.pdfSemenčenko, D. (2009). Faktori u izgradnji nacionalnog inovacionog sistema, Beograd.

Semenčenko, D., Kutlača, Đ., Štrbac, D., Živković, L. (2013, September). Kako pratititi razvoj nacionalnog inovacionog sistema – indikatori uspostavljanja trostrukog heliksa u Srbiji. Paper presented at the *20th conference „Technology, Culture and Development“, 40-52.*

Švarc, J., Lažnjak, J., Poljanec-Borić, S., Blečić, E., Perković, J. (2009). Barriers in research cooperation of WBC countries, WBC-INCO.NET deliverable 3.16, Zagreb. http://wbc inco.net/object/document/7116/attach/WBC_Research_barrieres_FINAL.pdf https://danube-inco.net/object/document/15279/attach/D4 15_Analysis_of_research_and_innovation_projects_in_teh_region_and_transferability_of_results_final.pdf

COMPETENCY OF REGISTERED FARMERS FOR INDEPENDENT BUSINESS

Slobodan Miladinović*[1], Nikola Ljiljanić[2]
[1]University of Belgrade, Faculty of Organizational Sciences
[1]Institute for Science Application in Agriculture, 68b Blvd. despota Stefana - 11000, Belgrade
*Corresponding author, e-mail: miladinovic@fon.rs

Abstract: *Subject of this paper is a state of competence of the owners of the registered agricultural holdings to independently lead operations of their farms. The aim of this paper is to determine the extent to which holders of registered agricultural holdings are trained to independently perform tasks which require basic economic and technical knowledge in business like bookkeeping, calculation of production costs, business plan, whether they use incentives for the development of agriculture, banking services and the like. Findings are not encouraging. Therefore, it is necessary to conduct an organized social action aiming to educate farmers in the area of keeping business on their farms. Advisory services play an important role in this process. Their task is to mediate between farmers and other institutions that may contribute to the development of agriculture.*

Keywords*: farmer, holding, knowedge, business, advisory sevices*

1. INTRODUCTION

Based on the Regulation of 2004 The Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia has started registration of agricultural holdings with the intention to have a clear record of who has the right to use the funds from the agricultural budget. The aim of these measures is to control the use of funds to encourage the development of agricultural production and the establishment of direct links with government services to agricultural producers, without intermediaries. Registration is based on a voluntary basis and is not related to the time period, but only the registered holdings have the right to use earmarked funds from the state budget for premium, subsidies and lending and other services of government extension services.

Into the Register of agricultural holdings may be entered: (1) natural persons - farmers, together with members of their family farm; (2) companies registered to perform agricultural production; (3) agricultural cooperatives; (4) entrepreneurs registered for carrying out the agricultural production, and (5) scientific research organization in the field of agriculture.

The subject of this paper is to analyze farms that are owned by private individuals. More specifically direct object of research is a state of competence of the household heads to independently lead operation of their farms. It is assumed that farmers are mostly lower educated and are generally not familiar with what is the bookkeeping, which it serves, how records of costs and revenues are kept and how to make a calculation of production costs, what is a business plan, whether they need assistance in its drafting, which it serves for, who gives incentives for the development of agriculture, how to apply for them, if they need assistance in applying for these funds, do they know which are the instruments of payments and the like. The aim of this paper is to determine the extent to which holders of registered agricultural holdings are trained to independently perform tasks which require basic economic and technical knowledge in business.

Here are analyzed the results of the survey research performed in 2014 in three regions of Serbia (Šumadija and Western Serbia, Southern and Eastern Serbia and the Belgrade region). It covers 344 villages in 83 municipalities. The survey was conducted by 73 interviewers - the adviser of total 167 currently engaged in the Agricultural Advisory and Support Service of the Republic of Serbia (AASS). They are arranged in 21 AASS covering the entire territory of the above mentioned regions (Institute for science application in agriculture, Report 2015). AASS advisors actively and continuously are monitoring agricultural production to 3,005 family farms selected according to the criteria for the selection of agricultural holdings (Official Gazette of the Republic of Serbia, 2014). Selecting the surveyed households is covered the entire territory of the observed region, made proper pattern dispersion, in proportion to the surface covered by AASS and the number of holdings for each AASS which came to approximate number of required number of surveys. In this way it is provided the homogeneous sample and comparable with the results of the Census of

Agriculture at the same time, as well as the mutual comparability of the indicators between the regions, thereby creating the conditions for the application of the comparative method where they are synthesized characteristics of the region and the entire sample. Data were collected in the field in written form, and then entered and processed in Microsoft excel and SPSS. The sample included 165 households with a dominant crop-livestock production. With only livestock production are 142 holdings, with a crop production is 43. These three types of households are represented with 68% in the total sample followed by fruit farms with 99 - wine with 15, vegetable farms with 38, beekeeping farms with 8 and 6 others.

2. FARMERS AND THEIR BUSINESS

According to the agricultural census in 2012 family farms dominate in the total structure of agricultural holdings in Serbia (99.6%), while the remaining 0.4% consists of legal persons holdings (companies, cooperatives) and entrepreneurs (Statistical Office of the Republic of Serbia: 2012: 190). According to the findings of the Census the total number of members and full-time employees on farms totaled 1,442,628 persons, of which 421,016 were holders of farms and 537,479 the members of households engaged in agriculture out of which 243,380 were employed full time throughout the year. These data refer only to households that are in the possession of more than 0.5 hectares of utilized agricultural land and/or above a certain number of cattle, poultry, etc. By this, 108,230 households and their members are excluded from the list (Bogdanov and Babovic, 2014: 20). Three years later, the structure remained practically unchanged (Trezor, 2016). At 31 December 2015 there were 346,135 registered farms in active status, of which 344,404 family farms, 1,448 agricultural enterprises, 114 agricultural cooperatives and 70 agricultural holdings with legal personality and 7 research organizations.

These data speak eloquently about the importance of agriculture in the overall economy of Serbia. Despite two and a half decades of transition, similar trends are happening which are registered in neighboring countries. In Serbia, outside the large urban centers and urban areas agriculture has a key importance for the development of the local economy but nevertheless it has a low economic efficiency. Similar trends were recorded in the neighboring countries and even those that joined the European Union, such as Romania and Bulgaria (Andrei Eftimie & Matei, 2014: 121).

Nowadays there is almost theoretical consensus that the family farm are socio-economic base around which is creating the peasantry as a social class and as long as it exists, it will reproduce interpersonal relations and the local cultural patterns typical for the rural environment. Additional problem is the fact that the land property of agricultural holdings is quite fragmented, consisting of a plurality of mutually separate plots, which only contributes that the overall agricultural production remains extensive. This greatly contributes to the fact that today's agriculture in Serbia lags behind on agriculture of the European Union, according to farmers' income and to the technical equipment, productivity and most of the other economic indicators (Mitrovic, 2015: 114).

In recent years, innovation has become one of the most important factors of economic development. They ensure the competitiveness of the market. Their importance is even greater in agricultural production since they enable the production of larger quantities of high-quality food for a steadily growing population and the need to release a wider and even the world market but also for the local and regional self- sustainable development.

In recent years, innovation has become one of the most important factors of economic development. They ensure the competitiveness of the market. Their importance is even greater in agricultural production since they enable the production of larger quantities of high-quality food for a steadily growing population and the need to release a wider and even the world market but also for the local and regional self- sustainable development. Therefore, modernization and implementation of innovations in agriculture should be seen as a very important factor in the competitiveness of agriculture, starting from the level of individual farms up to the level of the national economy (Rumanovská, 2013). In our conditions, one of the imperatives of economic development should be the development of sustainable agriculture based on innovativeness of production and business innovativeness. With regard to the overall structure of domestic agriculture particularly important place is occupied by registered farms, great attention must be just paid to vocational training of farmers to understand the importance of innovation not only in manufacturing but also in everyday business and farm management and to apply them in practice.

The problem is that our society may be understood as a society of belated modernization. This means that the majority of the population is dominated by traditional conscience and traditionalism as the dominant value orientation. Rural areas typically are not ready to accept modernization and innovations that it brings, and may be considered as centers of resistance to all major social changes (Pešić, 2015). Accordingly, it may be

expected that the rural population, including the holders of registered farms, is mainly traditionally oriented and that is not ready to change neither checked patterns of traditional ways of the agricultural production nor everyday social life. This fact constitutes an aggravating circumstance in any attempt to improve the agricultural production.

Given that one of the main objectives of each production is income generating (profit) then it is important for each producer to have permanent insight into the financial flows of its own business. Given that the Serbian agriculture is dominated by the production of a relatively small land ownership, and that farmers generally have low level of education, it is understandable that they did not have the habit of keeping accounting records of production costs and incomes. Another important question is whether if they may, with regard to their education, understand the importance and necessity of bookkeeping of its own holdings and whether they were sufficiently expert to independently perform their job.

Given that one of the main objectives of each production is income generating (profit) then it is important for each producer to have permanent insight into the financial flows of its own business. Given that the Serbian agriculture is dominated by the production of a relatively small land ownership, and that farmers generally have low level of education, it is understandable that they did not have the habit of keeping accounting records of production costs and incomes. Another important question is, with regard to their education, whether they understand the importance and necessity of bookkeeping on its own holdings and whether they are sufficiently expert to independently perform their job.

Table 1: Do you keep records of expenses and income of agricultural production on your holding?

Yes, I do	32.6%
Yes, I do it with the help of another person	41.7%
I do not keep records	25.0%
Yes, I pay an accountant	0.8%
Total	**100.0%**

Even nine-tenths of the holders of registered farms argue that they are familiar with the concept of bookkeeping records the cost of production (91.5%). Even though only three-quarters of them say that they keep records of the costs. This is a relatively high number of holders of registered farms. The assumption is that the record keeping is necessary, for various reasons, to obtain loans, grants, subsidies, aid from the various funds and similar but also for personal insight into the profitability of its own business. What is interesting is that only one in three keep personally this records, two-fifths of them do it with the assistance of a professional person while very few of them pay an accountant. So, for the contemporary registered farmers we may not say that they are enough versed or knowledgeable enough to take their own business on (registered) farms.

Of course, it's not just about the need to keep accounting records of production costs. Keeping family farm means not only responsibility for the successful business but also the ability to survive in the market conditions. This includes rationalization the business and achieving the cheapest possible production of a satisfactory quality and scope with the intention to achieve a satisfactory profit in the final realization of production in the market. Therefore, it is necessary to do the previous calculation of costs and benefits with the bookkeeping as well as the question of whether the farmer is able to do that alone. It is not necessary to speak about the importance this work. It is much more important question of whether the holders of registered farms practice it. Without it can not be assessed in advance the real profitability of the production cycle or the amount of expected profit.

Table 2: Are you doing calculations of production lines that you do?

Yes, with the advisers during their visit	69.0%
Yes, with an another expert	2.4%
Yes, I do it alone	9.5%
I do not do the calculations because I do not know how	19.0%
Total	**100.0%**

On the question of whether you make a calculation of your production lines seven-tenths of them answered that they makes it with the help of a professional person or adviser during their visit to the farm. Thus, the vast majority of them use the assistance of the advisor while a small number of them rely on the assistance of some other specialist and one in ten said that work on calculation himself. On the other hand, every fifth declare that they do not calculate their production lines. Ultimately, it means if they do not work the calculation they let go the elemental forces of the market and expose themselves to a series of accidents and adverse trends that can be counteracted by good planning.

Considering the above findings and observations, it may be assumed that the majority of farmers constantly need the help of an expert. On the other hand, it is required organized education just in the field of management of finances. This would expand their knowledge related to business problems which could help them in quality performance of their core business. It should be added the need for advisory services to have experts on this matter in their composition, but also that every advisor needs to know the basics of bookkeeping in order to help farmers who use their services.

Research findings show that two-fifths of the farmers (39.6%) had an opportunity to learn how to make evidence of expenses and income or making calculations on organized training while the rest (60.4%) claim that they learned to do it on the easiest way for them. The conclusion is that it is necessary to devise a systematic training to farmers to empower them for this activity. Of course, we can assume that the situation is much worse for those farmers who have not registered their farm. They rely solely on their own strength in business and they are left at the mercy of uncontrolled functioning of the market where perhaps the greatest benefit have middlemen and stockbrokers but direct manufacturer remains unprotected.

Lack of formal education has long been a major problem in the agricultural population. In recent years, it is significantly reducing their exclusion from education. Moreover, the research findings show that there is less of those whose education ends with 8 years of primary school (27.8%) compared to 34.43% in the general population according to the last Census (2011). There are significantly more of those who have some level of secondary education (62.2% compared to 48.94% according to the Census). We can conclude that those who have gone through a systematic formal education has primarily decided for registration and that on the other hand those who do not have formal education largely left to themselves. On the other hand, there are significantly less of those with higher education among them (11% compared to 16.24% of the total population). In contrast to this it is the fact that only 13.2% holders of registered farms have the agricultural education.

Here observed trends are typical for other transition countries. An example is Poland where, since 2000, has been observed trend of rapidly raising educational level of the rural population. There were registered 26.4% those with primary education, 61.4% with all levels of secondary education and 12% with high education (equivalent to higher and university education in Serbia) in 2011. In both countries, there is the same number of people who have agricultural education (13.2%) (Chmieliński & Karwat-Woźniak, 2015). Here should take into account the experience of Slovenia in which higher education of the farmer increases his chance to leave agriculture and go to any other occupation (Juvančič, 2005: 325). In the event that this tendency has been registered in Serbia, we would run the risk of reducing educational level of those who continue to engage in agriculture, which could have multiple negative consequences on the further development of agricultural production. It is therefore of particular importance to develop state aid for retaining educated in agriculture.

Table 3: Have you heard the term business plan and do you know what this is?

Yes, but I do not know what it is	19,2%
Yes, I know what it is	74,0%
c) No, I do not	6,8%
Total	**100,0%**

In the world of entrepreneurship business plan plays an important role. Today, many researchers believe that the business plan is of particular importance for the newly-established but also for small businesses (Brinckmann, Grichnik, and Kapsa, 2010: 24). If the registered farm look like a small company then owning a business plan plays a positive role in obtaining state aid, various subsidies, loans and the like. Business plan becomes more and more important in the organization of agricultural production. The data indicate that the majority of them, three-quarters (74.0%), declares that they heard about the concept of a business plan and to know what it is. One in five (19.2%) said that he heard but did not know what this is about until and approximately one in twenty (6.8%) declared that never heard of a business plan.

Table 4: Business plan

	Have anybody done a "business plan" for your holding?	**Do you know what is "a business plan" made for and if you can specify for what?**	**Do know/Do not know**
Yes	15.7%	74.8%	7,6%
No	84.3%	25.2%	92,4%
Total	**100.0%**	**100.0%**	**100.0%**

It is interesting that despite the fact that such a large number of registered farmers claimed that they are familiar with the concept of a business plan and to understand its essence and to know why it would be made (three quarters) still relatively few of them has even tried to made it (about one in seven), with the help of professionals. It must be admitted that this is quite unusual discrepancy between knowledge of the importance of something and trying its application, especially if it is about something that is of great importance in practice. Therefore, respondents were asked to indicate for what it is used. After examining the replies it was concluded that the vast majority of them however do not know what is the wright meaning and the purpose of business plan (92.4%). Only 10.7% of those who said that they know gave the right answer.

It follows from this that the average owner of a registered agricultural household does not have enough expertise for conducting their own business. Keeping the registered family farm is a specific type of entrepreneurial activity and it involves mastering of many skills and knowledge not only in relation to the technology of agricultural production but also to the management and entrepreneurship as well as too many other areas. From this arises the necessity of systematic professional training of farmers in different areas of knowledge.

Table 5: Using incentives and other funds

	Do you use incentives from the state for agricultural production?	Do you use incentives from the local government?	Have you heard of the possibility of obtaining financial resources for agriculture from EU pre-accession funds?	Do you know the way to receive these funds, and what do you need for it?	Have you had the opportunity to attend a lecture on which explained how to use the pre-accession funds?
Yes	98.4%	54.6%	86.2%	30.6%	27.8%
No	1.6%	45.4%	13.8%	69.4%	72.2%

One of the key issues in the operations of each business entity is issue of providing the necessary resources for normal functioning. Nowadays there are various funds which grants means to farmers for different purposes. The most important resources are mostly in state funds, funds of the local community and the pre-accession funds of the European Union in recent times. Of course, only registered farms could apply for obtaining these funds.

The data show that the registered farmers commonly use financial incentives from the state. Almost all of them do it. Taking into account the fact that the state's resources are given exclusively to registered farms, and then we can assume that this was a moment of great motivational significance in decision about the registration. The incentives that give local governments use a little more than half of the registered farm holdings, which only confirms previous finding.

It is interesting fact that the vast majority of registered farmers are informed about the possibility of obtaining financial resources for agricultural production from pre-accession funds of the European Union. These funds use a relatively small number of them, only three tenths. Despite the fact that many of them are informed of the possibility of obtaining aid from these funds, which are quite significant resources, most of them (more than two-thirds) is not informed in the way how to use these funds and what they need for and only one in four has attended the lecture which was discussed on how to use pre-accession funds. Thus, a significant majority of them do not have adequate knowledge about the possibilities and how to apply for obtaining those funds.

The global trend of the European Union, is that agriculture is supported and protected by Common Economic Policy with the intention to ensure the rational development of agricultural production and full utilization of factors of production and especially of the labor force as well as to increase revenues and provide adequate living standards of farmers. Some of the elements of the Common Agricultural Policy, by themselves, do not stimulate the growth of agricultural production, but given that they have the form of the transfer of knowledge related to agricultural holdings they have important significance for the final economic result in business of the holdings. The experience of the European Union in this regard is very inspiring. Various subsidies have given a special contribution to the development of agriculture but no less significance have the other means from the Rural Development Program that enable other aspects of adjustment to the conditions of market economy and overcoming severe competition (Kołoszko-Chomentowski, 2014: 65-66). This does not mean that it is exclusively about investing in production technology and equipment modernization. Great importance has investments in cultural and human capital of agricultural production and in the first place in

the training of farmers and members of their households on a variety of issues related to agricultural production and farm business.

It seems that the lack of information one of the key problems for faster and easier applying for various forms of support from the above mentioned state, local and international funds. Confirmation of this is found in the fact only 30.9% of them submitted the requests alone while 69.1% said they do it with the assistance of an expert or advisor.

Table 6: Using bank services

	Do you use loans to finance agricultural production?	Do you have the bank account?	Do you know what is a promissory note and what is it use for?	Do you know what is a check and what is it use for?
Yes	23,8%	97,7%	91,9%	97,1%
No	76,2%	2,3%	8,1%	2,9%

Based on the answers it can be considered that the majority of farmers are addressed to the possibility of their use when it comes to the use of banking services. Almost all (over 97%) have opened a bank account and know what the check is. Based on this we can assume that they are trained to perform basic operations related to receiving money and payments of liabilities to third parties. Many of them are probably forced to use banking services since the vast majority of legal persons with whom they cooperate carried out their financial operations exclusively through the account.

In addition to payments, it can be important for farmers some other banking services including perhaps especially important place has the option of taking the loan. Slightly less than a quarter of them say that they use bank loans to finance agricultural production. This is still a small part of them. Of course, we can ask why more of them does not do it with respect that the loan for many of them give chance to purchase the necessary equipment to build greenhouses or other facilities, irrigation, to buy some of the agricultural machine or something else that would have ensured expansion of production and acquisition of higher revenues in the future. The answers probably should be sought in high interest rates, confidence in the bank, long production cycles, unstable purchasing prices, uncertainty of operations due to dependence on natural disasters and etc.

3. CONCLUSION

General social modernization, which, among other things, is characterized by a rapid development and expansion of the educational system, is coming slowly to rural areas which are under the strong influence of traditionalism, relatively static and unprepared for significant changes in patterns of social behavior. This is reflected on the way of the business of agricultural holdings including registered farms which may be considered for more advanced part of the rural society.

This view is confirmed by the findings of the research. A very small number of farmers, owners of registered agricultural households are qualified to perform some of the basic activities related to independently doing business of their own holdings. Every third keep records of expenses and income and one in ten do calculation of its production lines, most of them do not know what a business plan is and why they should have it, many of them do not use the incentives provided by different funds. Moreover they do not know how they can apply for them. Many of them have attended various courses on the conduct of the business but obviously it is not enough to run their own farms. Certainly it requires a broader social action in order to introduce innovation in agriculture, modernize farms and the rural areas as well.

The question is how to accelerate the modernization of rural communities and agricultural holdings. In order to respond to it we firstly need to identify the key actors in the creation and transfer of knowledge relating to agriculture as a productive activity. The key actors in this process are (1) research and educational institutions that are responsible for the development of new ideas, (2) advisory services that mediate between researchers and innovators on the one hand and (3) the end-users of new knowledge on the other hand - the direct beneficiaries of knowledge (farmers) and indirect beneficiaries and i.e. various organizations that fulfill their goals through the application of new knowledge in agriculture and rural development (Tudor, Florian & Chitei, 2013: 91).

Intermediaries linking the farmers with the creators of knowledge and innovation have special importance in activating the direct beneficiaries of knowledge and innovation in agriculture. They ought to have direct cooperation with educational and research institutions and to suggest problems that notice on the ground in

direct contact with the farmers. Educational and research institutions should create specific training plans and programs which will aim to complete the skills that are necessary for the rational organization of agricultural production and management of farms. It is necessary regular interaction of all in the chain of transfer of knowledge for successful resolution of this problem.

REFERENCES

Andrei, Jean, Eftimie, Mariana, & Matei, Mirela (2014). „The Role of Romanian Farms in Valuing the Inland Agricultural Potential". *Journal of Food, Agriculture & Environment*, *12*(1), 1532-1535.

Bogdanov, Natalija & Babović, Marija (2014). *Radna snaga i aktivnost poljoprivrednih gazdinstava*, Beograd: Republički zavod za statistiku, 20.

Brinckmann, Jan, Dietmar Grichnik, and Diana Kapsa. (2010). „Should entrepreneurs plan or just storm the castle? A meta-analysis on contextual factors impacting the business planning–performance relationship in small firms." *Journal of Business Venturing* 25.1 (2010): 24-40. http://dx.doi.org/10.1016/j.jbusvent.2008.10.007

Chmieliński, Paweł & Karwat-Woźniak, Bożena (2015): "Changes in Population and Labour Force in Family Farming in Poland", *Studies in Agricultural Economics* 117 (2015) 140-146. p.142. http://dx.doi.org/10.7896/j.1511

Institute for Science Application in Agriculture (2015). Izveštaj o realizaciji savetodavnih poslova u poljoprivredi za II kvartal 2015. godine, Belgrade

Juvančič, Luka (2005). Characteristics of structural adjustment of agricultural holdings in Slovenia. *Jahrbuch der Österreichischen Gesellschaft für Agrarökonomie*, *13*, 311-329.

Kołoszko-Chomentowska, Zofia (2014). „Selected Effects of Financing of Agricultural Holdings in New Member States of the European Union", *Financial Internet Quarterly „e-Finanse"* 2014, vol. 10/nr 3, p. 65-72. 10.14636/1734-039X_10_3_005

Mitrović, Milovan M. (2015): *Sela u Srbiji: promene strukture i problemi održivog razvoja*, Beograd: Republički zavod za statistiku, 114.

Official Gazette of the Republic of Serbia (2014*). Regulation on Performing the extension services in agriculture in the Republic of Serbia*. No. 65/2014 No. 65/2014.

Pešić, Jelena (2016): *Vrednosne orijentacije u postsocijalističkim društvima Srbije i Hrvatske*, neobjavljena doktorska disertacija, Filozofski fakultet u Beogradu.

Rumanovská, Ľubica (2013). Evaluation of the Impact of Innovative Projects on the Competitiveness of Agricultural Holdings in Slovak Republic. *Scientific Papers Series Management , Economic Engineering in Agriculture and Rural Development* Vol. 13 , Issue 1, 337-343.

Statistical Office (2012). *Census of Agriculture 2012: Agriculture in the Republic of Serbia*. Belgrade: Statistical Office of the Republic of Serbia, 19.

Trezor (2016): *Broj registrovanih poljoprivrednih gazdinstava po organizacionom obliku na dan 31. decembar 2015. godine* http://www.trezor.gov.rs/rpg-statistika-lat.html

Tudor, Monica Mihaela; Florian, Violeta & Chitea, Mihai Alexandru (2013). "Acceptance of innovation diffusion in rural areas - a Romanian: Case Study" in Chmieliński, Paweł & Baer-Nawrocka, Agnieszka (eds). *Knowledge as a factor of rural development*. Institute of Agricultural and Food Economics - National Research Institute. Warsaw-Poznań, 81-106.

ACKNOWLEDGEMENT

This paper was written as part of the project "Tradition, Modernization and National Identity in Serbia and the Balkans in the Process of European Integration" (179074) which is implemented by the Centre for Sociological Research, Faculty of Philosophy in Niš, and funded by the Ministry of Education and Science of the Republic of Serbia.

MARKETING MANAGEMENT 881

PARTICIPATION IN ONLINE MARKETING RESEARCH PANELS: FINDINGS FROM FOCUS GROUP DISCUSSIONS 882
Ljepava Nikolina, Janičić Radmila

EFFECTS OF INDIRECT ADVERTISING IN VIDEO GAMES: ADVERTISERS' AND PLAYERS' PERSPECTIVE 889
Štavljanin Velimir, Kostić-Stavković Milica, Cvijović Jelena

ATTITUDES TOWADS INDIRECT ADVERTISING IN TV SERIALS 893
Kostić - Stanković Milica, Cvijović Jelena

IMPROVEMENT OF SERVICE ENVIRONMENT AT POSTAL NETWORK UNITS 898
Jovanović Bojan, Šarac Dragana, Kujačić Momčilo

OPTIMIZATION OF LOCAL PRINT MEDIA BUSINESS IN THE CONDITIONS OF TURBULENT ENVIRONMENT 806
Bubnjević Dalibor

GASTRONOMIC FESTIVALS AS A FORM OF BRANDING SERBIA AS A TOURIST DESTINATION 913
Vukic Milena, Kuzmanovic Marija, Vukic Ksenija

MARKETING AND SUSTAINABLE DEVELOPMENT 920
Jović Marija, Novčić Branka

SUSTAINABLE DEVELOPMENT OF STRATEGIC BRAND PARTNERSHIP 926
Vasilic Slobodan, Milosev Dejana

SPONSORSHIP OF SPORTS EVENTS AS A MARKETING TOOL 933
Petrović Mila, Vučinić Jelena

INNOVATIVE APPROACH TO ONLINE MARKETING FOR BOOK PUBLISHERS 940
Prtenjak Milan

MARKETING MANAGEMENT

PARTICIPATION IN ONLINE MARKETING RESEARCH PANELS: FINDINGS FROM FOCUS GROUP DISCUSSIONS

Nikolina Ljepava*[1], Radmila Janicic[2]

[1]American University in the Emirates, Dubai
[2]Faculty of Organizational Sciences, University of Belgrade, Belgrade
*Corresponding author, e-mail: nikolina.ljepava@aue.ae

Abstract: *Importance of online marketing research has been increasing over the years. According to ESOMAR report (2014) around half of overall research budget in market research agencies globally is spend on online research, and majority of quantitative online research is now conducted via online research panels. Three focus groups with University students were conducted with the purpose of exploring students' experiences with online research panels, motivations to participate in research and their general attitudes about participation in online survey research. Analysis of the qualitative data transcripts of the focus group discussions indicated that although participants took part in number of online surveys, most of them were not familiar with online research panels. Helping friends was identified to be a most frequent motive for survey participation. Aside from helping behavior, personal interest in a research topic, opportunity to share their opinions and opportunity to learn from the survey were also identified as motives for survey participation. Majority of participants considered current form of surveys obsolete and uninteresting and suggested a number of creative approaches to survey research and solutions for panel participant recruitment. Based on analyzed conversations recommendations are made for development of the recruitment strategies for panel research participants with more creative approach to online survey research, utilization of Internet multimedial potentials and social media integration in panel software.*

Keywords*: marketing research, Internet, panel research, focus groups, millenials*

1. INTRODUCTION

Technology development has enabled new ways of conducting research. Online surveys and qualitative research are becoming more common tools for conducting marketing research. New technologies along with a continuous increase in the number of Internet users worldwide, are bringing opportunities for further improvement of methods of online research. The share of online marketing research in overall marketing research activities has been continuosly increasing. According to the Internet Society Report (2015), a global Internet population in 2015 exceeded 3 billion users. It is estimated that by the end of 2016, 45% of the total population of the planet will use Internet. The highest rate of Internet usage is in North America, where Internet users make up to 87.9% of the total population. The incidence of Internet use clearly indicates that today's population is largely focused on Internet-based contents. This is especially true for younger generational cohorts, also called millennials, from educational and informative content, to entertainment, communications and online shopping activities, Internet use has become intertwined with most of their daily activities (Wang et al. 2015). A whole new generation of Internet-savvy customers emerged, and the need for finding out more about their habits and attitudes has became prominent in the past ten years.

Before the era of information technologies and Internet, survey data collection has been conducted in two ways: in person or by telephone. In the mid nineties with the introduction of web-based services as well as with the increase of number of Internet users globally, Internet was recognized as a suitable medium for carrying out quantitative research (Hoonakker & Carayon, 2009; Groves, 2011; Göritz, 2004). Hoonakker and Carayon (2009) suggested four possible methods to perform online quantitative research: (1) via e-mail attachment (Word document), (2) in the body of email messages, (3) .exe file within the email message, (4) a web-based questionnaire. In a web-based questionnaires survey is completed directly on the website, and data automatically stored on a web server. This concept was used for development of online research panels.

Online research panel is a pool of registered individuals who have agreed to participate in Web surveys on a regular basis (Göritz et al, 2000). An increasing number of market research agencies worldwide opted for

establishing their own online research panel. Evans and Mathur (2005) estimated that online research panels can be more cost-effective compared to traditional customer databases. Moreover, market research agency practices indicated that use of online research panel can considerably reduce the time required to conduct the survey. Over the time panel research became the most popular way for conducting an online marketing research, and quantitative online research today is increasingly conducted through online panels (Sikkel et al., 2009). The use of such research panels promises a high response rate, sample control, access to the general population, as well as detailed demographic information about the respondents and the possibility of preselection and segmentation desired group of respondents (Bruggen et al, 2011).

There are different sizes and structures of online panels. Panels may consist of consumers / customers, potential customers / users, partners, employees and other target groups - potential participants in research on specific topics. ESOMAR (2014) recommends having more than 10000 respondents in database in order for panel sample to represent online population in satisfactory manner. However, some online panels that are used by specific industries can have only several thousand members. At the same time, there is a number of large commercial international online panels with millions of registered participants from different countries. Typically, those panels (such as Cint, one of the largest online panels) consist of number of smaller specialized or local panels (Babin & Zikmund, 2015). This trend is also noticeable in Serbia: previous research conducted by Ljepava and Janicic (2015) indicated that approximately 80% of the interviewed market research agencies used online research panels with number of panel participants ranging from 2000 to 10,000 panelists.

However, McDaniel and Gates (2010) argued that establishment of online research panels led to the creation of specific category of professional survey participants. They indicated that professional survey participants often fill a number of different surveys on a daily basis, and that quality of collected information can be compromised. This is why it is very important to understand motivational factors that influence participants when joining online panels, and to carefully plan panel recruitment strategies as well as mechanisms for quality control. In order to achieve long-term successful implementation of online panel studies, researchers face several key issues: how to recruit a sufficient number of panel participans, how to maintain a critical mass of participants and continuously recruit new members, and how to motivate them to participate in studies and provide valid and credible information. Additionally, most of the information collected in quantitative research, is limited to participants' self-report. According to McDaniel and Gates (2010), such information can be subject to various flaws that may depend both on the methodological errors and ambiguities in designing research instruments, and on inadequate and inaccurate information provided by research participants.

The starting point in addressing all abovementioned challenges of online research panel is to understand the motivations of the respondents - the motives for both panel registration and research participation. The value of survey participation for the research participants is not always clear; completing the questionnaire requires cognitive effort, takes time and interrupts other activities respondent implements. Consequently, type of motivation for research participation can be an important factor affecting the quality of the collected data. (Bruggen et al, 2011). Žabkar and Kolar (2010) also discussed the importance of understanding of the Internet habits, behaviors and participants' motives for market research agency doing an online research.

The literature also indicates that there is a link between the level of Internet activity and participation in online research. For example, Göritz (2004) in her study showed that the response to participation in the panels was higher when the call for registration was distributed via email compared to more traditional recruitment methods.

In order to further explore motivational factors and habits of Internet users, specifficaly the group of Internet-savvy millennials, an exploratory focus group qualitative research was conducted in order to find out more about their knowledge and attitudes about online panels and survey participation, along with their willingness and motivation to participate in online panels.

2. METHODS

For the purpose of the present research, exploratory qualitative research has been conducted and three focus groups held with the students from University of Belgrade. The study included a total of 30 students divided into three groups of 10 participants per each focus group. Out of the 30 participants, there were 18

females and 12 males. Students responded to a series of questions related to their habits of Internet use, previous experience with participation in online research and survey participation, and attitudes and motivational factors influencing research participation. Focus groups were recorded and written transcripts created for each focus group, and then cumulatively analyzed in order to identify key themes. Qualitative analysis and content analysis were performed on collected data. Responses were categorized in accordance with the prevailing themes and presented cumulatively with the citation of the individual statements in order to illustrate a certain trend or prevailing attitudes about a particular subject.

3. RESULTS

Results of the analysis of the focus groups transcripts indicated that majority of the respondents use Internet continuously on a daily basis; consequently, they are mostly unable to determine the exact number of hours spent online. High level of Internet usage via mobile phone opens the possibility of continuous networking and interactions that are taking place throughout the day. Majority of time is spent on social networks, and besides social networks Internet is also extensively used for entertainment, informational purposes, and listening to a music.

Respondents generally do not like to participate in survey research, and the most common reason stated for participation is to help friends for a project or research. Additional motives for completing surveys are the possibility to express their opinion, to contribute to products or services improvement or to contribute to solving some social problems or increasing their visibility.

3.1 Internet and Social Media use

Facebook, Twitter and Instagram are found to be the most popular social networking websites, along with instant communication services such as Viber, WhatsApp and Skype. University students that participated in the research used social networks mainly to communicate and maintain contact with their friends and acquaintances, as well as to find information on latest news and events and friends activities.

When accessing Internet in addition to social networks (Facebook, Twitter and Instagram) participants spend most of their time on news websites (Blic, B92, Mondo) and extensively used YouTube. Websites with movies and TV series streams are also found to be very popular. Respondents also spend their time playing games, in many cases again in the context of social networks (specifically Facebook). A small number of respondents in this sample, mostly male, spends his time playing multiplayer MMPORG games.

"I cannot say how much time I spend online. When I see notification on my cell phone I check it."

"I use Internet continuously on a daily basis. I spend most of time on Facebook, YouTube and I read news on news portal such as Blic."

"We used to read printed newspapers. Now you can find anything you want online, that is cheaper and more convenient."

Participants are not frequent users of traditional media such as TV and/or newspapers and Internet is their main source of information. It has been observed that, for number of participants, social networks (specifically Facebook and Twitter) represented a starting point for information about latest news and events through content shared by their friends.

3.2. Web panels and survey participation

Majority of respondents considered online surveys to be boring, perceived participation in those surveys as a waste of time, and expressed low levels of motivation to participate in surveys. In most cases they stated that they will only participate in surveys in order to help a friend who is doing a research. Participants expressed particularly negative attitude towards Likert-scale type questions; a number of them stated that if there are too many Likert-scale type questions in the survey they would provide random response without carefully reading questions. Moreover, participants do not prefer to respond to open-ended questions in surveys where they need to write a more detailed response.

"I don't like to participate in surveys. I think it's a waste of time and their results often do not correspond to reality. "

"I filled out a number of online surveys. Frankly, I do not remember exactly what they were about. Mostly customer satisfaction surveys, some survey about juvenile delinquency ... I dont find then particularly interesting."

"My colleagues always ask me to fill out surveys for their research and I want to help them. "

"I do not like this scale type questions, they are boring and take too much time to respond"

"I do not like those surveys that are very long and have a number of some questions on a scale like agree disagree. I will only participate if a friend needs help."

It is interesting that a number of respondents considered participation in popular quizzes and personality tests on the web and social networks as participation in survey research. Although they are aware that majority of those tests have no scientific background, respondents stated that will participate in those tests regardless of their length and question type since they are finding them interesting and engaging, and they will receive test results immediately. Additional factor that influence popularity of those tests is the fact that results can easily be shared on social networks.

"What I love in such tests, is the fact that I can get results immediately after completing the test and I can share them on Facebook. I know they are not really scientific but they are fun."

" I participated in some surveys related to my colleagues' research to help them. And I like to participate in those fun surveys on Facebook that we can share on our profiles. "

"I don't t mind doing psychological tests and personality tests, but I find other type of surveys boring."

None of the respondents actively participated in a web panel. Some of them stated that they registered at some of the local online panels but they were never actively involved in a web panel. They were also not very familiar with the concept of earning by filling in surveys, although some of them were interested to find out more about this possibility.

Minority of respondents who declared that they participate in surveys on a regular basis stated that they more often participate in studies related to topic they feel close to, and that they would appreciate if they could see the results after filling in the survey. They are also willing to participate in a studies related to products and services of their interest.

"I want to fill out a survey in order to share my views, experiences, satisfaction and to give suggestions for further product development or improvement of services to which the survey refers."

"If a topic is interesting I will respond to a survey, but it is usually not."

Survey length and time needed to fill in the survey were also found to be an important factor. Most of the focus group participants were not willing to participate in a survey that takes more than 10 minutes to fill in. In a situation where they did fill in the longer surveys, they mainly did it to help a friend with a project, but they complained that that was too long, time consuming and in some cases they noted that they did not really pay attention to questions.

"I once helped my friend with his graduation project. The survey was too long; it took more than half an hour to fill it. I ended indicating any random response just to finish it. I do not understand this type of research I don't believe any of the respondents carefully reads those questions and whats the point in that? "

3.3. Motivational factors for survey participation

When asked what would motivate them to participate in surveys aside from helping their friends, respondents mostly identified intrinsic factors such as contribution to a social cause, opportunity to provide opinion, opportunity to suggest improvement of products and services. Generally, majority of the participants expressed willingness to participate in surveys that cover important social, cultural, humanitarian or economic issues; on the other hand, there were less willing to participate in commercial marketing survey unless they are specifically interested for services or products. The prevailing view is that surveys that aim to

draw attention to a social problem can motivate participants more, compared to strictly commercially-oriented surveys. In addition, opportunity to express opinion and to influence a change can also motivate participants to participate in a survey research.

"An interesting topic and the opportunity to affect some important social issues."

"Surveys should draw the people's attention to a problem and try to find way of solving the same. If I know that my response really means something, that something can be improved and changed based on my opinion I will gladly participate in such survey. "

"Survey should be interesting and informative. I would be motivated to fill in the survey that serve the common good and maybe the survey from which I can learn something new. I am also very much interested in psychological surveys and tests"

Participants were also more willing to complete a survey if survey topic was related to their personal interests. They also emphasized the importance of survey being short, concise, and specific in order for survey completition rate to be high. Respondents also consider survey research to be a valuable source of information, and for some of them possibility to access results is also important factor that can influence their decision to participate in certain survey.

"If a topic is interesting I will participate. For example, recently I participated in a survey related to improving conditions for the use of bicycles as a means of transportation in Belgrade."

"Survey should be short, specific, related to the topic of my interests in order to complete it. I believe people participate in surveys they want their voices heard. "

".. to create short, clear, simple survey, explain why it is conducted and to be able to access the results."

"Survey research can provide us with opportunity to find out more about the society and people, of course, if the results of these studies are available later."

3.4. Suggestions for conducting online survey research

In order to find out more about participants' opinions and suggestions related to online survey research, respondents were asked to discuss how they would perform online survey research if needed. In recruitment strategies respondents mostly relied on snowball sampling via social networking websites, starting from their own circle of friends. Among social networks suggested for recruitment Facebook was dominant, although some respondents perceived the possibility of using other social media channels in order to recruit participants for online research.

"I would probably use Facebook in order to collect data. I would post the link on my profile and ask my friends to share it"

"I would post a link on social networks and I would also directly contact my friends via direct messages and emails. If I had some money to invest I would pay a banner on some popular websites to recruit more people."

"I would open a dedicated Facebook page and promote it via Facebook ads in order to recruit people to fill in the survey."

Respondents believe that online surveys should be short, interesting and engaging for participants. It is indicative that most of the respondents stated that they would completely change the form of surveys, their visual design and level of interactivity. They believe that the existing forms of online surveys are outdated and that possibilities of multimedial presentation on Internet should be used and surveys presented in more creative forms, such as games, quizzes, videos and graphical presentations in order for surveys to become more interesting for potential participants. They also emphasized the importance of accessing the results and having a possibility to easily share the results on social networking websites.

"I'd like to try something creative because this form of surveys is now outdated and boring."

"I'd make a game (something similar to logo quiz for example) in order to make it interesting. Survey feedback and possibility ti view results is also very important. "

"I'd maybe make surveys the form of a comic book. Also results should be immidiatelly accessible and shareable on social networks – this is also a way to promote a survey and to gain more attention and recruit more participants."

4. CONCLUSION

Importance of using online tools for conducting marketing research has been increasing over the past ten years. Number of market research and public opinion research agencies using research panels for online survey research has been continuously increasing both globally and regionally. In order for panel survey results to represent opinions and attitudes of a specific consumer/target group, special attention needs to be given to recruitment strategies in order to minimize number of extrinsically-motivated professional panel participants.

The present research provided an insight into motivations and attitudes related to online research participation of an average University student. The research indicated that respondents are avid Internet users, who use Internet daily and continuously with majority of participants not being able to determine the exact number of hours spent online. Although they devote most of their online time to social networks, Internet is also used for entertainment, informative purposes, and leisure time. These findings are in line with online behavior habits of University students in other countries and regions indicating that there is a number of similarities in millenials' behavioural patterns worldwide when it comes to online behavior and daily Internet use. These patterns of Internet use place focus group participants into a group of potentially valuable online panel participants; however, majority of students that participated in focus groups were not familiar with the concept of online research panels.

Almost all participants have experience in participating in online surveys, although a number of them considered participation in the popular quizzes and tests equal to research survey participation. Opposed to standardized questionnaires and surveys, that they believe to be mostly uninteresting and boring, participants stated that they gladly participate in popular and psychological quizzes and tests and that they find them interesting and engaging. Participants also suggested a number of changes in survey visual presentation and levels of interactivity in order to make surveys more interesting and engaging for participants. The findings indicated that researchers should consider re-thinking a paradigm of survey research, moving from classical forms of survey research transferred from classical face to face to telephone research, to new, multimedial, more interactive form that would be more interesting and engaging to new generation of millennials. Research also showed that survey participation is primarily intrinsicaly motivated with following motivational factors prevailing: helping behaviour, possibility to express opinion and to contribute to improving products or services, possibility to contribute to some social issue that respondent consider to be important and possibility to learn something from survey results.

Overall, the research indicates that for the new millennials generation of prospect survey participants, the traditional approach to survey research might not be efficient in a long term, especially for Internet-based surveys. Multimedial online environment provide number of opportunities for creation of more engaging and dynamic content, and researchers should consider using these opportunities along with social media integration in order to make survey more appealing for prospective participants, increase the number of panel participants and quality of data collected.

REFERENCES

Babin, B. & Zikmund, W. (2015). Essentials of Marketing Research 6th Edition. Cengage Learning.

Bruggen, E., Wetzels, M., Ruyter, K. & Schilewaert, N. (2011). Individual differences in motivation to participate in online panels. International Journal of Market Research, 53 (3), 369-381.

ESOMAR Global Market Research 2014: An Esomar Industry Report, accessed on 19.10.2015 https://www.esomar.org/uploads/public/publications-store/reports/global-market-research-2014/ESOMAR-GMR2015.pdf.

Evans, J.R., Mathur, A. (2005) The value of online surveys. *Internet Research. 15(2),*195-219.

Göritz, A. S., Reinhold, N.& Batinic, B. (2000). 3 Online Panels. Online social sciences, 29.

Göritz, A. S. (2004). Recruitment for online access panels. International Journal of Market Research, 46(4).

Greenhow, C., Walker, J.D., & Kim,S. (2009). Millennial Learners and Net-Savvy Teens? Examining Internet Use among Low-Income Students. Journal of Computing in Teacher Education 26(2), 63-68.

Groves, R.M. (2011). Three eras of survey research. Public Opinion Quarterly, Vol. 75, No. 5, 2011, 861–871.

Hoonakker, P.& Carayon, P. (2009). Questionnaire survey nonresponse: A comparison of postal mail and Internet surveys. International Journal of Human-Computer Interaction, 25, 348-373

Internet Society Global Report, accesed on 14.11.2015 http://www.Internetsociety.org/globalInternetreport/assets/download/IS_Web.pdf

Ljepava, N. & Janičić, R. (2015). Analiza poslovnih praksi i perspektive razvoja onlajn marketinških istraživanja u Srbiji, Synthesis 2015, 38-42

McDaniel, C., Gates, R. (2010). Marketing Research with SPSS, International Edition John Wiley and Sons Inc.

Sikkel, D., Hox, J. & De Leeuw, E. (2009). Using auxiliary data for adjustment in longitudinal research. Methodology of longitudinal surveys, 141.

Wang, Y., Niiya, M., Mark, G., Reich, S. and Warschauer, M. (2015). Coming of Age (Digitally): An Ecological View of Social Media Use among College Students. CM Conference on Computer Supported Cooperative Work and Social Media (CSCW'15)

Zabkar, V. & Kolar, T. (2010). Consumers in Slovenia: Values, Personality Types and Consumerist Attitudes: Market (Tržište), 22(2). 205-222.

EFFECTS OF INDIRECT ADVERTISING IN VIDEO GAMES: ADVERTISERS' AND PLAYERS' PERSPECTIVE

Velimir Štavljanin[1], Milica Kostić-Stanković[1], Jelena Cvijović [*2]
[1]University of Belgrade, Faculty of Organizational Sciences
[2]Economics Institute
*Corresponding author, e-mail: jelena.cvijovic@ecinst.org.rs

Abstract: *Modern trends in the field of marketing communications require the implementation of new instruments that would enable easier adjustment of the characteristics of target groups, delivering the desired message and achievement of desired effects. Given the expansion of the video game industry and the increasing number of users, of all demographic and sociological profiles, computer and video games have become one of the most attractive medium for advertising. Indirect advertising in video games is specific in relation to other types, both direct as well as indirect advertising, and, therefore, the focus of this paper is to identify its key advantages and disadvantages from the side of advertisers. As yet there are not enough studies on this subject, so more complex research in this area are necessary in order to understand the real potential of this modern channel for advertising.*

Keywords*: indirect advertising, video games, characteristics, effects*

1. INTRODUCTION

In the recent time, besides television, the interest for Indirect advertising has expanded to other forms of media, particularly on video, computer and online games (Chaney et al., 2004; Schneider, Cornwell, 2005; Nicovic, 2005; Yang et al., 2006). The expansion of industrial video and computer games influenced the development of consciousness of advertisers about their potential as an effective channel for advertising. An increasing number of users make video games and computer games attractive for advertising (Yang et al., 2006; Russell, Stern, 2006), mainly due to a simple reaching to the target group of consumers through the integration of products in games' plot (McClellan, 2005).

Studies in the US show that 42% of the population play video games and players can be identified among all age groups, with 26% of players under 18 years, 30% aged between 18 and 35 years, 17% of those between 36 and 49 years and 27% of those older than 50 years. Men make up 56% of the players, and women 44%. When it comes to the average player, in case of men, it is 35 years and for women 44 years (ESA, 2015). Revenue from advertising in video games showed an annual growth rate of 11.2% for the period from 2010 to the present. In 2010, global revenue from advertising in video games was around 1.9 billion US dollars, in 2014 it counted 3.1 billion US dollars and, by the end of 2015, it amounted to 3.41 billion US dollars. Projections for 2016. Says it will even reach 3.72 billion US dollars in 2016 (Statista, 2015).

The increasing sophistication of mobile technology, as well as the degree of personalization and customization of mobile games, makes the sphere of the games industry attractive for advertisers, though, for now, it is dominated by forms of mobile phone games designed specifically as a promotional means for individual brands (Eng. Advergames). These games are less complex and demanding than classic games, in which brands are incorporated. Due to the simplicity of design, it can be easily distributed among players (Cauberghe, De Pelsmacker, 2010).

2. EFFECTS OF INDIRECT ADVERTISING

Indirect advertising in video games has a number of positive aspects. It may be noted that the main advantage is the experiential nature of video games, thanks to which the desired information about the products are marketed to active and engaged audience (Sierra, Taute, 2013). Certain studies on this subject have indicated that the interactive environments in video games encourage better memory of marketing information (Jeong et al., 2008; Jeong et al., 2011). This is due to the different treatment of messages placed by an indirect advertising and entertainment media than those obtained through traditional advertising. While in the case of traditional advertising, consumers usually recognize the commercial function of the message, it triggers their skepticism and resistance and limits the effects achieved (Obermiller et al., 2005), Indirect

advertising is less likely to activate these mechanisms of defense (Grigorovich, Constantin, 2004). Also, in the case of traditional advertising, the brand message has been the focus of attention of viewers, whereas in the case of indirect advertising, audience consciously participates in entertainment content, which occupies its primary attention, while simultaneously receiving advertising messages (Lowrey et al., 2005).

For the video game industry, indirect advertising can provide extra income, taking into account that advertisers are paying for the incorporation of the product in scenario of games. Another important advantage is enhancing reality gaming (Yang et al., 2006). Improving the technology of video games provide advertisers the opportunity to create extremely realistic simulations of their products, thus improving the unique experience of the players. Some games designed as simulated motor racing, imitate a very real scenarios that could be equated with "test drives" of various brands of cars in the real world (Mackay et al., 2009).

For this reason, the results of some studies suggest that the audience believes that indirect advertising actually improves the experience by increasing the realism of certain media formats (Avery, Ferraro, 2000). Similarly, Nelson et al. (2004) found that, in terms of players, realistic sports games depends significantly on the brands that appear in the game. An additional advantage of indirect highlighting in video games is the possibility of identifying players with famous sports figures that appear in the game (Nelson, 2002). In fact, 17.9% of regular players of video games take into account the celebrities involved in the game as one of the main reasons for their consumption (ESA, 2015).

Indirect advertising has a longer lifetime than conventional advertising (d'Astous, Chartier, 2000). The lifespan of brands that are embedded in video games can be an important (Nelson, 2002), especially in the case of regular players of this game. In addition, the practice of dynamic ads in the game that can be easily changed often, so, an opportunity to incorporate new brands and preventing obsolescence is higher (Shields, 2005).

Studies have shown that audience, generally speaking, has a positive attitude towards indirect rather than direct advertising. In addition, most players do not have a critical attitude to advertising in video games does not consider that it affects their attention and distort a unique experience, and does not consider this type of advertising to be a deception (Nelson, 2002).

For advertisers, an important concept is personalized indirect advertising because it increases the positive experience of players and increases the time and frequency of play (Kwak et al., 2010). A study of Hang, and Auty (2011) found that allowing players to choose integrated brand that will "use" in a video game increases the efficiency of advertising. The results of this study clearly indicated that a group of players who had the opportunity to choose a brand they prefer, have a more positive experience in comparison with the group to which personalization was not enabled.

However, like other instruments of advertising, indirect advertising in video games can have negative aspects. Given all the common practice of advertising in video games, not enough research has been done in relation to its actual effects. Little is known about the extent to which advertising in video games affects the attitude of players toward certain brands and buying behavior (Yang et al., 2006). Although some studies have indicated that indirect advertising really influences the development of awareness of brands that occur and that the interactive nature of video games is responsible for this (Nelson, 2002), some authors suggest that it may just be a barrier to achieve maximum effect in terms of advertisers (Vorderer, 2000). Unlike television shows and movies that require the presence of a passive audience, video games require manipulation of control functions and progress through the game (Yuping, Shrum, 2002 Yuping, Shrum, 2005). Therefore, interactive features of video games can reduce the perceptive possibilities of the members of the audience, because their attention is divided between what we visually perceive and control the game (Grodal, 2000 Chaney et al., 2004; Nicovich, 2005). For example, Shapiro and Krishnan (Shapiro, Krishnan, 2001) found that, when the attention of the audience is divided between visually displayed advertising messages and listening to the sounds unrelated to them, remembering advertising messages becomes reduced.

Still, it is still not entirely clear how the interactivity of video games and the active role of players can affect the indirect effects of advertising when the memory comes to advertising messages (Yang et al., 2006). By conducting two studies on sports games Nelson (2002) found that players remembered from 25% to 30% of the brands that they saw immediately after they finished the game, and 10% to 15% of brands after five months of playing. A telephone survey conducted in 2005, which included testing of men aged 18 to 34 years, found that more than 25% of the players could not remember the indirect advertising from the last session of play (Activision, 2004). It is interesting to note that about 33% of the players in the survey mentioned that indirect advertising in video game influences their behavior at a later purchase (Activision,

2004). The research carried out by Chaney, Chaney and Lin (2004) found that players who prefer games with a first-person shooting cannot remember stating that his character "passed" virtual billboards in the game, but there were little or no recall of brands or even product categories displayed on billboards. Similarly, Grigorovich and Constantin (2004) pointed out the complex relationship between the type of indirect advertising (virtual billboards in relation to the displayed objects) and later ability to recall their names. For example, players tend to more easily remember brands when they were placed as billboards, from those that are otherwise presented related to the plot of the game, except when it comes to brands of cars. Accordingly, there is a possibility that indirect advertising has not reached full effect in video games, because the interactivity and involvement in the game that could affect the ability to perceive advertising messages. However, one must keep in mind that advertising in interactive video games has an impact on both explicit and implicit memory. Previous studies have shown reduced indirect effect of advertising on explicit memory than is the case with implicit. This means that even though players often cannot explicitly recall brands that were seen in video games, indirect advertising can affect their implicit memory and, hence, the subsequent buying decisions (Yang et al., 2006)

There are differences in the perception of the message and the achieved effects depending on how and where brands are "embedded". Studies have shown that audio-visual and verbal forms are easier to remember than purely visual forms. Russel and Stern (2006) found that verbal forms are better remembered than visual and that the connection with the action has no effect on auditory form, while improving memory of visual form. Due to the above mentioned reasons, the involvement in the game harms memory of discreetly displayed brands (Grigorovich, Constantin, 2004), while more prominent brands will probably be better remembered (d'Astous, Chartier, 2000).

Another disadvantage makes the violent content of many video games, which have been shown to instill an aggressive mindset and violent behavior of users (Anderson, Bushman, 2001), which may adversely affect the image of the brands that are advertised that way. Also, in some video games, realistic models of real weapons of real producers appear, which otherwise could not be legitimately advertised, therefore, indirect advertising of such products entails certain ethical questions.

3. CONCLUSION

Indirect advertising in computer and video games is undoubtedly a perspective media for advertising, taking into account the speed of the development of the games industry and the need to use innovative types of advertising in order to achieve the best effects. Based on the analysis of literature, it is obvious that it has positive effects on audience memory and attitudes when advertising strategies with are aligned with characteristics and preferences of target groups. Also, brands should adequately fit into the context of the game and be displayed in a way that enhances the gaming experience. Usage of interactive elements and, whenever possible, allowing players to personalize their characters has also shown to be valuable. The brand should be displayed in a way that is not invasive, but which draws attention and raises awareness of the brand. Finally, it is highly recommendable to conduct evaluation of the effects achieved by indirect advertising for the purpose of modifying and improving this practice in the future, so it would fit best the preferences of advertisers and audience.

REFERENCES

Activision. (2004). Activision and Nielsen Entertainment Team to provide advertisers with standardized measurement metrics for video game audiences. Retrieved from: www.investor.activision.com/ ReleaseDetail.cfm?ReleaseID=149231/

Anderson, C. A., Bushman, B. J. (2001). Effects of violent video games on aggressive behavior, aggressive cognition, aggressive affect, physiological arousal, and prosocial behavior: A meta-analytic review of the scientific literature. *Psychological Science*, 12 (5), 353-359.

Avery, R. J., Ferraro, R. (2000). Verisimilitude or advertising? Brand appearance on prime-time television. *Journal of Consumer Affairs*, 34, 217-244.

Cauberghe, V., De Pelsmacker, P. (2010). Advergame: The impact of brand prominence and game repetition on brand responses. *Journal of Advertising*, 39 (1), 5-18.

Cauberghe, V., De Pelsmacker, P. (2010). Advergames. *Journal of Advertising*, 39(1), 5–18.

Chaney, I.M., Lin, K-H., Chaney, J. (2004). The effect of billboards within the gaming environment. *Journal of Interactive Media*, 5(1), 54-69.

Entertainment Software Association – ESA. (2015). ESA's 2015 essential facts about the computer and video game industry.

Grigorovici, D. M., Constantin, C. D. (2004). Experiencing interactive advertising beyond rich media: Impacts of ad type and presence on brand effectiveness in 3D gaming immersive virtual environments. *Journal of Interactive Media*, 5(1), 31-53.

Grodal, T. (2000). Video games and the pleasures of control. In: D. Zillmann and P. Vorderer (eds.), *Media Entertainment: The Psychology of Its Appeal*. Lawrence Erlbaum, Mahwah, NJ, 197-213.

Hang, H., Auty, S. (2011). Children Playing Branded Video Games: The Impact of Interactivity on Product Placement Effectiveness. *Journal of Consumer Psychology*, 21(1), 65-72.

Jeong, E. J., Biocca, F. A., Bohil, C. J. (2008). Effects of representational realism in 3D violent games. In A. Spagnolli, L. Gamberini (eds.), PRESENCE 2008: Proceedings of the Eleventh Annual International Workshop on Presence, Cooperativa Libraria Universitaria Padova, Padova, 191-200.

Jeong, E. J., Bohil, C. J., Biocca, F. A. (2011). Brand logo placements in violent games: Effects of violence cues on memory and attitude through arousal and presence. *Journal of Advertising*, 40(3), 59-72.

Kwak, D.H., Clavio, G.E., Eagleman, A.N., Kim, K.T. (2010) Exploring the Antecedents and Consequences of Personalizing Sport Video Game Experiences. *Sport Marketing Quarterly*, 19(4), 217-225.

Lee, M., Faber, R.J. (2007). Effects of product placement in on-line games on brand memory. *Journal of Advertising*, 36(4), 75-90.

Lowrey, T. M., Shrum, L. J., McCarty, J. A. (2005). The future of television advertising. In: A. Kimmel (ed.), *Marketing Communication: Emerging Trends and Developments*, Oxford University Press, New York, 113-132.

Mackay, T., Ewing, M., Newton, F., Windisch, L. (2009). The effect of product placement in computer games on brand attitude and recall. *International Journal of Advertising*, 28(3), 423-438.

McClellan, S. (2005). Study: In-Game integration. Adweek, 46/47, 9.

Nelson, M. R. (2002). Recall of brand placements in computer/video games. *Journal of Advertising Research*, 42, 80–92.

Nelson, M. R., Yaros, R. A., Keum, H. (2006). Examining the influence of telepresence on spectator and player processing of real and fictitious brands in a computer game. *Journal of Advertising*, 35(4), 87-99.

Nelson, M. R., Keum, H., Yaros, R. A. (2004). Advertainment or adcreep: Game players' attitudes toward advertising and product placements in computer games. *Journal of Interactive Media*, 5(1), 3-30.

Nicovich, S.G. (2005). The effect of involvement on ad judgment in a video game environment: The mediating role of presence. *Journal of Interactive Advertising*, 6(1), 29-39.

Obermiller, C., Spangenberg, E., MacLachlan, D. L. (2005). Ad skepticism: The consequences of disbelief. *Journal of Advertising*, 34(3), 7-17.

Russell, C. A., Stern, B. B. (2006). Consumers, characters, and products. *Journal of Advertising*, 35(1), 7-21.

Schneider, L-P., Cornwell, T. B. (2005). Cashing in on crashes via brand placement in computer games: The effects of experience and flow on memory. *International Journal of Advertising*, 24(3), 321-343.

Shapiro, S., Krishnan, H. S. (2001). Memory- based measures for assessing advertising effects: A comparison of explicit and implicit memory effects. *Journal of Advertising*, 30(3), 1-13.

Shields, M. (2005). A new dynamic. Brandweek, 20.

Sierra, J. J., Taute, H. A. (2013). Experiential consumption of video game and in-show ads: Phenomenological explanation through thought experimentation. *Journal of research for consumers*, 24, 57-87.

Statista. Global video games advertising revenue from 2007 to 2016 (in billion U.S. dollars).

Vorderer, P. (2000). Interactive entertainment and beyond. In: D. Zillmann and P. Vorderer (eds.), *Media Entertainment: The Psychology of Its Appeal*. Lawrence Erlbaum, Mahwah, NJ, 21-36.

Yang, M., Roskos-Ewoldsen, D.R., Dinu, L., Arpan, L.M. (2006). The effectiveness of 'in-game' advertising: Comparing college students' explicit and implicit memory for brand names. *Journal of Advertising*, 35(4), 143-152.

Yuping, L., Shrum, L. J. (2002). What is interactivity and is it always such a good thing? Implications of definition, person, and situation for the influence of interactivity on advertising effectiveness. *Journal of Advertising*, 31(4), 53-64.

Yuping, L., Shrum, L. J. (2005). Rethinking interactivity: What it means and why it may not always be beneficial. In: M. R. Stafford and R. J. Faber (eds.), *Advertising, Promotion, and New Media*, M.E. Sharpe, Armonk, NY, 103-124.

ATTITUDES TOWADS INDIRECT ADVERTISING IN TV SERIALS

Milica Kostić - Stanković[1], Jelena Cvijović [*2]
[1]University of Belgrade, Faculty of Organizational Sciences
[2]Economics Institute
*Corresponding author, e-mail: jelena.cvijovic@ecinst.org.rs

Abstract: *This paper investigates the impact of indirect advertising on American television series audience in Serbia. On the basis of current theory in this area, the study assesses following audiences' attitudes on various types of indirect advertising. Full-length episodes were used as experiment stimuli and accompanied questionnaires were filled in natural environment in order to obtain more accurate results. Three groups of factors: presentation likability, proactive behavior and attitudes towards audio placements appear to be influential to the overall advertising success, while the proactive behavior generated the best results and, therefore, should be considered as the most important.*

Keywords*: indirect advertising, attitudes, audience, TV serials, experiment*

1. INTRODUCTION

Since contemporary marketing environment is more and more characterized by focused communications and media fragmentation, it is obvious that effects of traditional advertising are gradually reducing (Perez-Latre, 2009). Also, various electronic devices allow audience members to easily skip advertising blocks (O'Neill, Barrett, 2004), so they are becoming more distant to traditionally advertised messages. As a result, advertisers are searching for more innovative and effective ways to reach their target audiences, which resulted in increasing use of indirect advertising (Smit et al., 2009; Babacan et al., 2012), which is simply defined as brands' and products' inclusion in different media content in order to influence viewers' attitudes and behavior. This communication instrument is used for targeting more complex and more marketing-aware audience members (Hackley, Tiwsakul, 2006) because they most often do not perceive embedded products as advertising forms (Guido et al., 2010). That is happening due to the effective integration of products and brands within different situations of plotlines, which enables audiences to receive brand messages in more natural situations that significantly reduce the possibility of their rejection. Indirect advertising has, therefore, become one of the important differentiation strategies of corporate brands and products (Wilson,Till, 2011) which affect their brand image and viewers' attitudes towards them (Arrazola, 2013). Also, the important fact about product placement is that it is effective for all three sides – advertiser, which implements innovative promotional strategy, the medium or the production, which gains financial benefits and auditorium which gets new kind of branded entertainment (Russell, Belch, 2005).

Nowadays, indirect advertising appear in movies, television shows, music videos, novels and video games. Although mediums of indirect advertising differ, the main purpose of its every form is to obtain the ad recall and positive affective reactions (Moser et al., 2004; Lehu, 2007). That happens most often due to audience's positive perception of a medium or plot protagonists, which reflects further on the brand image or attitude and, eventually, may stimulate purchase behavior (Wiles, Danielova, 2009). Therefore, one of the main types of advertising effectiveness are brand attitudes (affective outcomes) (Balasubramanian et al., 2006). However, indirect advertising should be used moderately, as exaggeration may produce a negative impact on the audience and its effectiveness may decrease, as they gradually start to recognize the advertising intention (Homer, 2009; van Reijmersdal et al., 2010). Therefore, it is highly important to detect reactions and preferences of target audience first, before implementing any of indirect advertising strategies. Although this kind of research is common in USA and some European countries, in Serbia it is still not the case. So, a gap is detected in both, theory and practice, which should be thoroughly investigated in order to improve advertising practice in developing countries and gain certain value for both, advertisers and audience and make a step in that direction.
.

2. ATTITUDES TOWARDS PRODUCT PLACEMENT

The study was performed in 2015. On the sample of one hundred and fifty seven participants. All respondents, aged 19-23, were undergraduate students at the Faculty of Organizational Sciences, University of Belgrade. Majority (70.5%) of respondents was female, while 29.5% were male. All respondents

voluntarily participated in the research. This research was based on watching of three episodes of American serials shown on television in Serbia by participants and answering questionnaires. These episodes were chosen as the experimental stimuli because they contained at least 23 examples of product placements and their plot can be considered relevant to the sample of participants. Two of the episodes lasted approximately 20 minutes, while the last one lasted little less than 42 minutes. The questionnaire consisted of various statements that could be evaluated on the Lickert scale (from 1-Absolutely disagree to 5 – Completely agree). Following statements appeared in the questionnaire:

In this part of the research, the goal was to investigate which groups of positive attitudes related to indirect advertising influence placement success best. Previous research have shown that the vast majority of viewers takes a positive attitude towards indirect advertising (Kramoliš, Drábková 2012), especially as it contributes to the viewing experience (Redondo, Holbrook 2008; Sung et al., 2009). However, opposite situation can happen – it can trigger counter arguing or irritation (Cowley, Barron 2008; van Reijmersdal 2009) and negative attitudes if indirect advertising intrudes viewing experience (Cowley, Barron 2008; Wei et al., 2008). Russell (2002) found that viewers' attitudes were more favourable in case of visual and low plot connected and auditory and high plot connection placements, than in case when they were incongruent – visual with high plot connection and auditory with low plot connection. Some researchers found that inclusion of the brand is crucial for the effectiveness of indirect advertising (Kamleitner & Jyote, 2013). Indirect advertising is accepted as an essential part that adds value if they are perceived to be connected to the plot (Yang, Roskos-Ewoldsen, 2007; Yoon et al., 2011; Dens et al. 2012). On the other hand, if indirect advertising is observed as intrusively integrated sales pitch, the effects could be negative (Homer, 2009). Dens et al. (2012) found that plot connection is not a sufficient factor to cause positive effects more than a marginally significant change towards positive attitudes. Some researchers found no difference in attitudes toward subtly and blatantly placed brands if program liking is moderate and exposures are limited to one viewing (Cowley, Barron 2008; Gillespie et al., 2012). The few studies indicated that prominence can have a negative effect on attitude toward placed brands (Bhatnagar et al., 2004; Dens et al. 2012). On the other hand, subtle placements are less likely to provoke negative shifts in attitudes. Law and Braun (2000) found that there is an increase in brand choice after viewers' exposure to (Cowley, Barron 2008; Gillespie et al., 2012). Indirect advertising may also improve brand attitudes without necessarily be highly recalled (Cowley, Barron, 2008). Also, positive attitude is transferred from a well-known actor or well-liked scene to a presented brand. However, there is also a potential negative shift in viewers brand attitudes after they feel forced to view some brand information (Lee et al., 2011).

In order to detect the most influential groups of attitudes, exploratory and confirmatory factor analysis of obtained results were performed and three crucial components were determined (see Table 1) that appeared to be correlated with indirect advertising success, measured in percentage of recalled brands. The first subgroup, titled "Presentation likability" (PL), represents the general attitudes towards brands shown in TV serials and it consists of following statements: "The way brand is used or shown in TV serials affects my attitude towards it" (marked as PL 1); "When character I like uses some brand in TV serials, my attitude towards that brand becomes more positive" (marked as PL 2); "When character I dislike uses some brand in TV serials, my attitude towards that brand becomes negative" (marked as PL 3). The second subgroup, determined as important, was the one called "Audio placements" (AP), which consisted of attitudes towards placements that are solely mentioned in TV serials and it consists of following statements: "I don't mind when characters in TV serials mention or talk about some brands" (marked as AP 1); "I like when characters in TV serials refer to some brands" (marked as AP 2); "I don't mind when names of famous brands are often mentioned in TV serials (marked as AP 3)". The third subgroup, titled as "Proactive behavior" (PB), consists of statements regarding making certain actions after seeing product placements in TV serials. They are: "I actually searched for brands I saw in TV serials on Internet and/or in stores" (marked as PB 1); "I wish to try certain brands after seeing it in my favorite TV serials" (marked as PB 2); "I started using some brands after seeing them in TV serials I regularly watch" (marked as PB 3). Obtained regression factor scores of three components were introduced into multiple regression analysis and results imply that the third component (Proactive behaviour) is statistically significant predictor of recall success (standardized $\beta = 0{,}170$; $p < 0.05$) (see Figure 1).

Table 1: Principal component analyses of attitudes towards product placement and their impact on overall placement recall

	Component		
	1	**2**	**3**
PD2	0.853		
PD3	0.829		
PD1	0.795		
AP1		0.886	
AP3		0.853	
AP2		0.792	
PB4			0.882
PB5			0.805
PB6			0.724

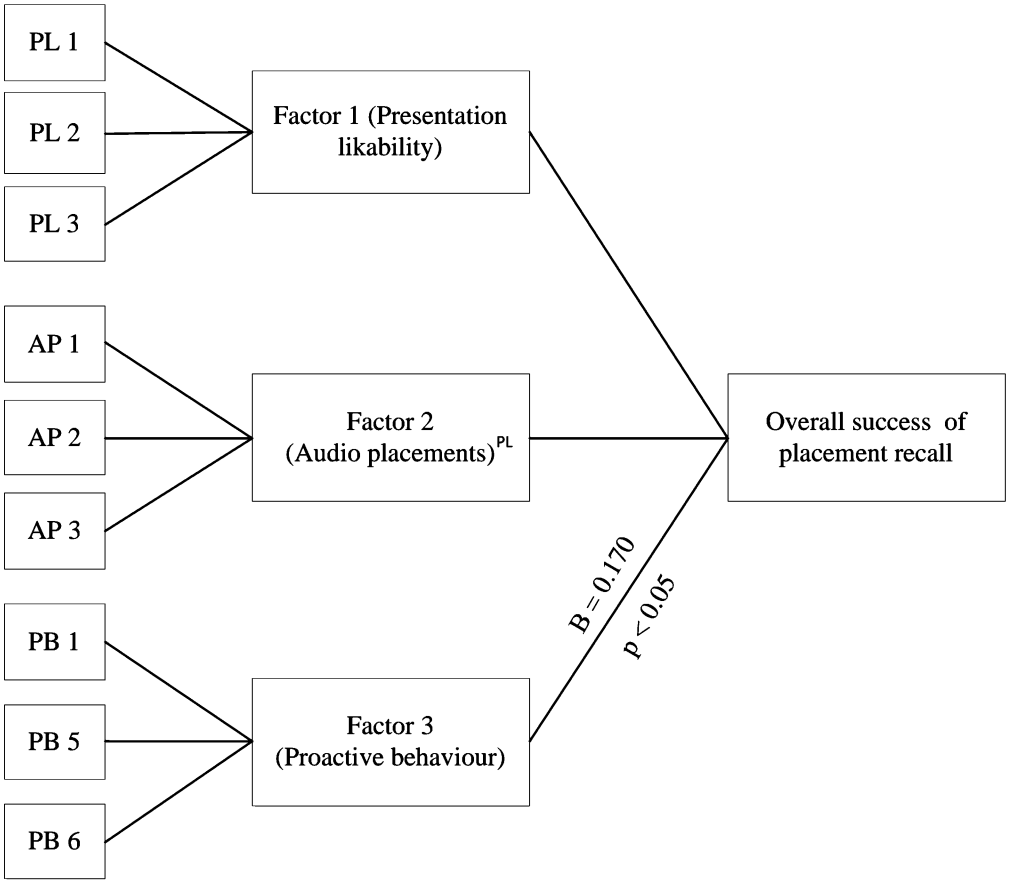


Figure 1: The impact of three groups of attitudes on overall placement recall success

The important finding is identification that proactive behavior of respondents (searching information on placed brands, desire to possess and consume certain brand and actual consumption of placed brands) influences the overall success of indirect advertising. In another words, placed brands indeed generate viewers' action, and, therefore, reach the advertisers' major goals. Since there are certain limitations of this study, it can be used as the theoretical basis for more complex analyses in the future.

3. CONCLUSION

This research supports the growing theorethical and empirical evidence that indirect advertising has become effective marketing communication instrument. It has shown that it impacts audience in Serbia, although it is sill not frequently used in domestic media space. Since viewers are often exposed to indirect advertising incorporated in popular foreign TV serials that are shown on national and cable television stations, it is obvious that its effects should be investigated thorougly. This research offers basis for future planning and implemetation of indirect advertising as communicaation instrument, in accordance with viewers perceptions and attitudes, in order to obtain desired effects. The results show that advertisers should place focus on more subtle placements, although it might appear that explicitly integrated ones achieve better results.

REFERENCES

Arrazola, M., de Hevia, J., Reinares, P. & Reinares Lara, R. (2013). Do new forms of television advertising occasion better recall than traditional advertising spots? *International Journal of Advertising*, 32(2), 281–300.

Babacan, E., Akçali, S.İ. & Baytekin, E.P. (2012) Product Placement as a Rising Marketing Communication Activity: An Assessment on Television Serials. *Procedia: Social and Behavioral Sciences*, 62, 1319-1331.

Balasubramanian, S.K., Karrh, J.A. & Patwardhan, H. (2006). Audience Response to Product Placements. *Journal of Advertising*, 35 (3), 115-141.

Bhatnagar, N., Aksoy, L. & Malkoc, S.A. (2004). Embedding Brands Within Media Content: The Impact of Message, Media, and Consumer Characteristics on Placement Efficacy, in *The Psychology of Entertainment Media: The Blurring of the Lines Between Entertainment and Persuasion*, (Ed.) Shrum, L.J., pp. 99-116. Mahwah, NJ: Lawrence Erlbaum.

Cowley, E. & Barron, C. (2008). When product placement goes wrong: The Effects of Program Liking and Placement Prominence. *Journal of Advertising*, 37(1), 89–98.

Dens, N., De Pelsmacker, P., Wouters, M. & Purnawirawan, N. (2012). Do you like What you Recognize? *Journal of Advertising*, 41 (3), 35-54.

Gillespie, B., Joireman, J. & Muehling, D.D. (2012). The moderating effect of ego depletion on viewer brand recognition and brand attitudes following exposure to subtle versus blatant product placements in television programs. *Journal of Advertising*, 41(2), 55-65.

Guido, G., Peluso, A.M., Tedeschi, P., Nicole, C., Lauretti, C. & Caciula, A. (2010). Acceptance of Product Placement in Italy: Effects of Personality and Product/Consumer Interactions. *International Journal of Marketing Studies*, 2(2), 34 – 46.

Hackley, C. & Tiwsakul, R. (2006). Entertainment marketing and experiential consumption. *Journal of Marketing Communications*, 12(1), 63-75.

Homer, P.M. (2009). Product Placements. *Journal of Advertising*, 38(3), 21–31.

Kamleitner, B. & Jyote, A.K. (2013). How using versus showing interaction between characters and products boosts product placement effectiveness. *International Journal of Advertising*, 32(4), 633–653.

Kramoliš, J., & Drábková, M. (2012). Types, Forms and Major Product Categories of Product Placement in the Czech Republic. *Journal of Eastern Europe Research in Business and Economics*, 6 (2), 47-54.

Lee, T.D., Sung, Y. & de Gregorio, F. (2011). Cross-Cultural Challenges in Product Placement. *Marketing Intelligence and Planning*, 29(4), 366–384.

Lehu, J-M. (2007). Branded Entertainment: Product Placement and Brand Strategy in the Entertainment Business. Philadelphia: Kogan Page.

Moser, H.R., Bryant, L. & Sylvester, K. (2004). Product placement as a marketing tool in film and television. *National Social Science Journal*, 22(1), 76-86.

O'Neill, E. & Barrett, M. (2004). TiVo – The next big thing – DVRs and television advertising models. *World Media Economics Conference – HEC*, Montréal, CA.

Perez-Latre, F.J. (2009). Advertising fragmentation: The beginning of a new paradigm, in *The advertising handbook,* (Ed.) Powell, H., Hardy, J., Hawkin, S. & MacRury, I., 34–46. London: Routledge.

Redondo, I., Holbrook, M.B. (2008). Illustrating a systematic approach to selecting motion pictures for product placement and tie-ins. *International Journal of Advertising*, 27(5), 691-714.

Russell, C.A. (2002). Investigating the Effectiveness of Product Placements in Television Shows: The Role of Modality and Plot Connection Congruence on Brand Memory and Attitude. *Journal of Consumer Research*, 29, 306-318.

Russell, C.A. & Belch, M. (2005). A Managerial Investigation into the Product Placement Industry. *Journal of Advertising Research*, 45(1), 73–79.

Smit, E.G., van Reijmersdal, E.A. & Neijens, P.C. (2009). Today's Practice of Brand Placement and the Industry behind It. *International Journal of Advertising*, 28(5), 761–82.

Sung, Y., de Gregorio, F. & Jung, J.H. (2009). Non-Student Consumer Attitudes Towards Product Placement. *International Journal of Advertising*, 28(2), 257–285.

van Reijmersdal, E.A. (2009). Brand Placement Prominence: Good for Memory! Bad for Attitudes? *Journal of Advertising Research*, 49(2), 151–153.
van Reijmersdal, E.A., Smit, E.G. & Neijens, P.C. (2010). How media factors affect audience responses to brand placement. *International Journal of Advertising*, 29(2), 279-302.
Wei, M-L., Fischer, E. & Main, K.J. (2008). An Examination of the Effects of Activating Persuasion Knowledge on Consumer Response to Brands Engaging in Covert Marketing. *Journal of Public Policy and Marketing*, 27(1), 34-44.
Wiles, M.A. & Danielova, A. (2009). The Worth of Product Placement in Successful Films: An Event Study Analysis. *Journal of Marketing*, 73(4), 44-63.
Wilson, R.T. & Till, B.D. (2011). Product Placements in Movies and on Broadway. *International Journal of Advertising*, 30(3), 373–398.
Yang, M. & Roskos-Ewoldsen, D.R. (2007). The Effectiveness of Brand Placements in the Movies: Levels of Placements, Explicit and Implicit Memory, and Brand-Choice Behavior. *Journal of Communication*, 57(3), 469–489.
Yoon, S., Choi, Y.K. & Song, S. (2011). When Intrusive Can Be Likable: Product Placement Effects on Multitasking Consumers. *Journal of Advertising*, 40(2), 63-75.

IMPROVEMENT OF SERVICE ENVIRONMENT AT POSTAL NETWORK UNITS

Bojan Jovanović*[1], Dragana Šarac[1], Momčilo Kujačić[1],
[1]Faculty of Technical Sciences, University of Novi Sad
*Corresponding author, e-mail: bojanjov@uns.ac.rs

Abstract: *National postal operators have an impressive network of postal units, which occupy prestigious locations in settlements. Customer's waiting is an inherent element of the services provision in postal network units. Improving service environment, or interior of the postal unit has the same importance for customers as does the service level of the requested services. This paper considers the improvement of waiting process during the realization of service delivery at postal network units. Waiting phenomenon is analyzed. Current situation at postal network units is observed. Possibilities of improving the current situation towards developing a marketing concept are considered, in order to create a proper service environment.*

Keywords: *postal unit, customers, service environment, waiting time, digital signage*

1. INTRODUCTION

The realization of activities in service industries is usually inseparably connected with forming of queues. Considering that complete elimination of queues is economically unjustified, the efforts are focused to establish optimal levels of service and to find a balance between customer requirements and requirements of the service provider. This is also the situation in postal office units.

National postal operators are faced with important changes in their business area during the last decades. The task that is set in front of them is to reform themselves into market sustainable entities, that can successfully deal with growing direct and indirect competition. Besides direct competition, that provides the same kind of services as national postal operators, indirect competition with technology development provides substitutes for traditional postal services, which leads to decreasing demands for services offered by national postal operators.

Meeting universal service obligation, national postal operators have developed significant infrastructure capacities over time, which is primarily reflected in extensive network of postal units. Besides the burden which that resource represents in relation to maintenance costs, it has a large potential for improving the market position of national postal operators, which is not fully utilized in most cases.

The quality of service delivery at postal network units, from a customer's point of view is most commonly viewed as time spent waiting before being served at an adequate counter. In that way, one of the basic questions is how to improve conditions in waiting space and to achieve that queueing process passes as painlessly as possible for customers. If value-added services are not provided in postal units, technological improvement will dramatically reduce the scope of realized services.

2. CUSTOMER WAITING EXPERIENCE

Waiting is usually inseparably connected with a sense of displeasure. Pleasure can be defined as a dimension of experience that refers to hedonic tone (Barrett and Russell, 1999). Taking into account that waiting comes in between customers and their wishes, waiting often creates frustration and lower level of the sense of pleasure. Shorter queues lead customers to desired aims more quickly, thus contributing to a more positive overall evaluation of the service (Maister, 1985). People are also more likely to notice others who are in front of them in the line (perceiving them as an obstacle), rather than those standing behind them in the line. The question is why the number of people who are behind a particular customer is also important. Certainly, a large number of people behind a particular customer indicates a large queue length. Perceiving a large queue can lead the customer to two conclusions (Zhou and Soman, 2003):

- it may serve as a social validation that the service is worth waiting
- it may lead the customer to expect a longer queue if he returns at another time

These conclusions make the customer less willing to leave the queue. Also, the number of people behind can lead to the process of social comparison. It becomes obvious especially when waiting is unpleasant. In that case a large number of customers behind is experienced like "there are customers in a worse position". On one hand, waiting process is focused on achieving a personal goal, and at same time it contains a social dimension, where other individuals want to achieve same goal. This act of social comparison with people in the queue who are behind, who are not so lucky as the customer making the comparison, can contribute to a feeling of comfort (Zhou and Soman, 2003). Some of the basic motives for social comparison include: self-evaluation, self-improvement and self-preservation (Taylor et al., 1996). The motive of self-evaluation originates in a human need to have a stable and precise mark for oneself. When objective standards for self-evaluation do not exist, people usually turn to social comparison, in other words they evaluate themselves through the prism of comparison with others. The motive of self-improvement refers to the desire to improve oneself. Self-preservation refers to the interest in maintaining positive feelings about themselves. Since waiting is an unpleasant experience that causes frustration and stress, customers in queues may search comfort and try to reduce anxiety and anger through comparisons with users behind them. Seeing a large number of people behind them, users can have a positive affective reaction, which leads to the decision to remain in the queue (Zhou and Soman, 2003).

Negative reactions in terms of waiting are usually associated with the outcome of a certain experience and a choice that results in the experience (Voorhees et al., 2009). The outcome of the experience is covered by the user's anger, which represents a negative emotion that arises from the experience of waiting. Customers' regret can be evaluated by their selection of a particular service provider. The evaluation of users' choices is not only influenced by their experience, but also by the perceived benefits from missed alternatives (Tsiros and Mittal, 2000). After negative experiences such as waiting, customers often experience regret about their choices. Regret in service realization can be experienced in a number of situations from a sense of false timing for make a decision to dissatisfaction with the service. As a result customers can regret their decision to visit a post office if there is a large crowd, or be dissatisfied with empathy of workers at the counter.

3. MARKETING COMMUNICATION

Marketing communication is expected to provide feedback from service customers, as well as from all entities that have a direct or indirect impact on business results. Postal services operators realize marketing communications through:

- advertising - a form of communication with the purpose of influencing the current and potential customers, and their selection of services provided by the postal operator;
- public relations - represents "management function that establishes and maintains mutually beneficial relationships between an organization and the public on whom its success or failure depends" (Cutlipet al., 2000);
- sales promotion - includes additional actions to increase the scope of provided services that are aimed at rewarding existing and attracting new users (various giveaways, promotional price for a certain period, "aggressive" campaigns in the areas of service implementation, etc.);
- personal selling - postal operators implement this set of activities through counter workers or sales representatives who are focused on the segment of large customers; it requires an appropriate structure of counter workers, which is the result of: selection of workers, constant training, information and stimulation; vendors of services for large customers are required to have: a highly-professional staff who is well familiar with technology, postal services, user characteristics, characteristics of competitors, good verbal skills (presentation skills), etc.

Taking into account that postal units are places where customers come to a direct contact with postal employees, they have a considerable potential for the implementation of the marketing concept. An appropriate mix elements of marketing concept can contribute to improving the customers experience with queues.

3.1 Service systems

Primary questions posed in organizing service systems are (Durrande-Moreau, 1999):

- How can we help customers during the waiting?
- How can we make this time more agreeable?
- How can we avoid impatience?
- How can we give managers relevant recommendations concerning this weakness in the quality of their service?

Since the customer's satisfaction with services is under the influence of perceptions of waiting time, an alternative approach to the problem of waiting can be made in finding ways to make the passage of time as fast and comfortable as possible (Pruyn and Smidts, 1998). Maybe one of the easiest conditions for the queue management is the control of the environment in which it takes hold. In terms of the realization of the service, ambience or atmosphere is often designed to provide customers satisfying experience with the service and to create a desired image with the aim of causing a positive evaluation of service quality.

Customer behavior is the result of his emotional state and his individual experience that is influenced by the environment (Mehrabian and Russell, 1974; Barrett and Russell, 1999). The elements of the environment can cause different customer emotions, which results in a certain customer's behavior (Chienand Lin, 2015). Environmental elements include ambience, design and social elements (Baker et al., 2002). Ambient elements can be seen as sensual (lighting, temperature, music). The design elements are tangible and visual (color effects, furniture, spatial layout). These elements belong to the group of physical elements and can be an important factor in managing the perception of time, as well as the emotional response on waiting (Hui et al., 1997).

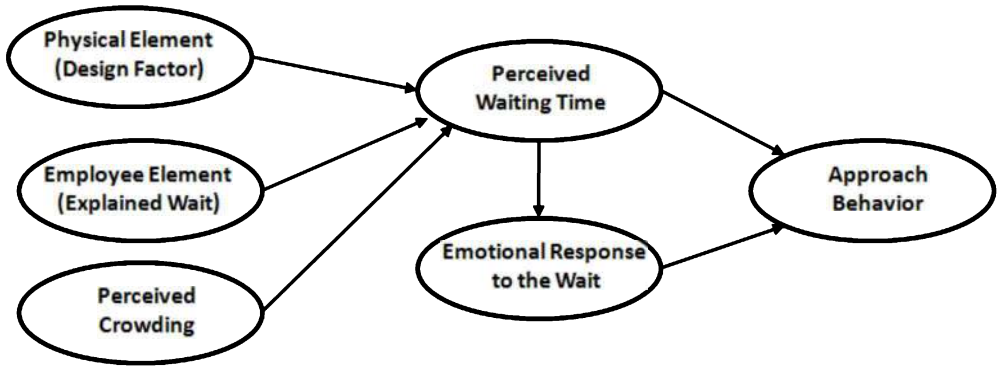


Figure 1. Estimates of the perceived waiting time route (Chien and Li, 2015)

In Figure 1 it can be seen that the observed waiting time is directly influenced by: physical elements, employees and observed level of congestion in the realization of services. Perceived waiting time causes an emotional response on waiting. Finally, the perceived waiting time together with emotional response on waiting, determine the behavior of the customer while waiting to be served.

The theory of justice can be used for grouping customers inside social interaction with employees, where interaction can be viewed from the perspective of interactional and procedural justice (Goodwin et al., 1991). Interactional justice during waiting includes visibility of employees, whereas procedural justice includes fairness and an explanation for waiting. In the case when the number of employees is less than the current state demands, customers becomes frustrated and angry. This situation is particularly evident in cases when even if it is obvious that the system is overloaded, and the activation of new available capacities (new service channels) is missed.

3.2 Digital signage

Advertising activity contains several vectors (Marion and Berengen, 2004): a still image, a moving image, a sound and a written word. With the aim of better understanding the conscious and unconscious messages transmitted by an advertising spot there are two possible approaches: semi-pragmatic and audio-visual.

Semi-pragmatic approach considers two areas of communications: information content and relationship that is established in the advertising message. The subject facing advertising spots faces the picture first, which has a greater power of integration than words. Regardless of the fact that images belong to the domain of the unreal, they provide the illusion of immediacy. The development of pictorial representation (from drawings and paintings, photography to the film) resembles a permanent quest towards a greater degree of realism. It can be said that there are tendencies to cover up the unreality of images in favor of transparency (attempts to make an image a direct connection with reality, not just a show of reality). Image tries to provide certain segments of reality, usually through already familiar forms. The processes of assimilation on the basis of proximity (i.e. on the basis of similarity) represent relatively unconscious cognitive processes. Such processes have influenced the formation of opinions and customers shows, in that way that customers are not aware (this is used a lot in advertising with the aim of reaching to the basic cognitive level of customers).

The audiovisual media are formed by integrating sound, image and movement, where the movement connects the other two elements, enabling the visual aspect of the current dimension in order to achieve the illusion of life in space and time. Movement dictates a tempo in audiovisual media where the arrangement of rhythmic, dynamic and kinesthetic sensations forms a whole that represents a coherent set. Such processes use audio and visual channels, so it can be observed like a transfer of meaning between two or more sensory systems (processes of synesthesia). Taking into account that processes of synesthesia belong to relatively unconscious processes, for advertisers they are an effective way to persuade potential customers. Audiovisual media can be based on the principle of empathy or on its absence (Marion and Berengen, 2004). Digital signage is a rapidly evolving market, whose products replace paper-based posters with public electronic displays. The success of this concept is based on reducing the costs associated with printing and updating of printed materials. More and more companies are starting to use this type of media and its capabilities, combining them with various forms of external activator (video processing, RFID, NFC, etc.). So the basic question is how to provide the appropriate content for a specific segment of customers at the appropriate time.

Digital Screenmedia Association defines digital signage as "the application of electronic displays or screens (LCD, LED, plasma, etc.) for delivering entertainment, information and/or advertising in public or private spaces outside the household". Basic components of digital signage include: display / screen, content on the display and some form of content management system.

Unlike traditional signs, digital content can be changed quickly. Another advantage is reflected in the fact that the content of digital signage can be delivered in different ways besides static image, (content can be interactive via the touch screen or via motion control). Digital signage can include technologies that enable a certain system to recognize the observer's age, sex and in some cases applies technology to recognize facial expressions. These technologies offer a possibility for digital signage to deliver targeted messages in a very efficient way. During the specified time interval, a larger number of messages adapted to specific audiences can be broadcast by using techniques such as daily broadcasts (period of time during the day is divided into segments so that a targeted message can reach target audience at the right time). Through digital signage the interaction between viewer and content is enabled (by touch or navigating through mobile devices). Another advantage of digital signage is reflected in the fact that it can achieve audience analysis by specific content. Apart from these obvious advantages of digital signage, the biggest obstacle to wider application is a relatively high initial investment (although, in the long run, the return on investment is much higher with a digital signage in comparison with traditional advertising) (Bauer et al., 2011).

There are three basic types of digital signage related to (Kelsen, 2010): point of sale, point of wait and transit hubs. The main objectives of digital signage at the point of wait are: communication through key messages that are oriented on brands and products related to service providers, increasing customer satisfaction so that it affects their perception of waiting time and providing interesting and relevant content in different ways. In situations where customers are waiting for the realization of certain services they represent "captive audience" (Schaeffler, 2008). Digital signage, that is positioned and presented in a good way (with appropriate and stimulating initial content) can contribute to not only the feeling of faster flow of time but also leads to the inclusion of other products or services that are provided to customers.
Factors such as the size of the display, installation height or angle of the display in regard to the direction of customer movement can have a significant impact on the user's perception. Nevertheless, the content of advertising has the decisive influence on customer's expectations, in other words whether the user expects interesting content (Müller et al., 2009). If advertising transmits relevant information, the customer will see that as a benefit, otherwise it can be seen as an unnecessary cost for the user. Digital signage systems include at least three key market participants, depending on whether the platform and space are provided from the same or different entities (Bauer et al., 2011):

- advertiser is a participant whose product or service is promoted,
- customer is the person to whom the content is directed
- and platform provider is an entity that provides digital signage network (infrastructure, software, customer rights management, content management).

There can also be a space provider, as the owner of the space where displays are installed. The space provider can often be the same entity that promotes a product or service or entity that provides a platform for advertising.

Considering the increasingly demanding customers, modern advertising should also fulfill the requirements in terms of aesthetic appeal, informativeness, emotional outreach to observers, and bring observers to the state of surprise through appropriate advertising rhetoric (Beyer et al., 2009). Computer techniques for

reading, analyzing and influencing the cognitive-emotional state of the customer represent a new field of research to discover the range of external conditions such as pleasure, boredom, anger or intensive mental activity. By merging the patterns of behavior with physical information about the customer, the system is enabled to become aware of the customer.

Adapting to the customer means adjusting the process of inclusion of the observer and the inclusion of balanced content according to the customer's cognitive-emotional state. An application that involves downloading "fingerprint" of observers to detect his content awareness and facial expressions in order to reach to the indicators that indicate whether the applied social technique is justified from his point of view, or an another type of content will be selected and put to the forefront. Thus, the system can transmit more information or more entertainment content if an observer shows indications of declining attention to details or emotions that may prevent the effective reception of information.

Basic advantages of digital signage over traditional static tags are reflected in the fact that the content can be changed instantly, at any time without major effort. The content can be adapted to the context or to present customers, and may even be interactive. It can have the following functions:

- informative - providing various pieces of information, which are important for the participants,
- advertising which refers to the location where it is,
- advertising for third parties,
- improve the customer experience - reducing perceived waiting time,
- influencing customer behavior - incorporating in the queue management,
- brand building – as a part of the decor, which creates an image of a certain brand.

4. POST OFFICES OPPORTUNITIES FOR ADVERTISING

In order to improve the customer's experience with the service process in post offices, and bearing in mind the opportunities to influence the subjective customer experience with past waiting time, we are considering the advertising potential of post offices. Apart from that, this tendency makes space for postal operators to improve their relations with customers, as well as to show them the full range of services that can be provided.

The continuous changing of market relationships creates the need for some kind of organized public relations. The basis of the relationship with the public is making an impact on the public, establishing and improving the image and so on. The purpose of communication with the public is to achieve marketing goals and defined policies of business operators.

Delayed pieces of information have extremely negative consequences on the postal systems. In order to ensure the survival of the postal systems on the market, it is necessary for them to own a competitive system for the exchange of information. In that way, the necessary preconditions are met for the assessment of their own capabilities, and also for defining business strategies. Segments that are essential for the survival on the market are: customers, competitors, the government and the public. Business communication with customers of postal services represents a continuous activity, which includes efforts to identify the needs of customers and familiarize them with the services.

Postal system can be emphasized as an important channel for advertising. It is estimated that around 300,000 users pass through postal network units of PE Post of Serbia per day. Advertising can be placed in three segments: for their own use, for the purposes of third parties and for the public needs (the state and state authorities). In the Post of Serbia there are certain activities within the first two options, which are grouped into the following options that are available (Post of Serbia, 2015):

- advertisement on poster places (the possibility of placing the poster content in over 500 post offices in the territory of the Republic of Serbia);
- advertisement by holders gives the availability of promotional materials (flyers) in places where holders are arranged;
- delivery of flyers at counters in postal network units (after the requested service is performed, employees at the counter directly deliver the advertising materials (flyers);
- display of branded items (branded items of third parties are placed on counters within a counter hall);
- promotion in the postal network units (placing of promotional equipment (stands), the presentation of products or services with the engagement of promoters, giving the possibility of direct contact with potential customers);
- advertising on plasma screens (88 of most frequented post offices are selected and they are supplied with plasma screens);

Plasma displays are supposed to have the greatest advertising potential. However, this concept has not been developed in the direction to fully exploit opportunities that Post of Serbia has. The original content of broadcast consisted of advertising sequences which referred to the segment of Post Express service. The question that has not been resolved in the development of the concept refers to the elements that influence customers and draw their attention to the broadcast content. The answer to this question may be found in the analysis of customer's interest points during the process of waiting. In that situation the customer is primarily interested in waiting time. Queue systems with tickets are certainly an optimal solution for these problems. They provide unquestionable comfort for the customers, when their presence is not required at a particular place to "defend" their position in the queue. In addition to that, their attention is attracted to the monitor displaying the data concerning the direction towards a defined service channel. That approach leads to the situation where the customer moves are forced, in other words his attention is directed to the control monitor. When all the prerequisites are fulfilled, a high level of efficiency of advertising content can be achieved. Unlike the previous approach, where content existed, but there was no certainty that it would reach each customer waiting in the line, the situation is changing in that each customer (who wants to be served) is actively or passively directed to advertising sequence.

The previous business of postal operators shows that the total population of customers is not homogeneous. Therefore, it is in their interest to divide users into characteristic groups. The most massive segment of customers (standard) requires special attention, as their relationship with the employees directly affects the service quality and the overall image of the company. Considering the range of realized services, they are subject to standardization, so that they can be predicted and organized (a customer comes to a pre-prepared and selected position, requiring a service for which the staff is adequately prepared). Models of behaviour with certain categories of customers are derived from a certain business policy and appropriate business strategies through a process of internal communication. Predictability of communication allows standardization of customer's requirements. Among the important factors that affect the process of communication with this group of customers are: environmental conditions, organizational behaviour and direct communication.

The counter is not only a place for work and provision of information, but it can also serve as a place for getting information (proposals, suggestions). Counter workers are expected: to professionally implement business activities, to be polite, kind, hardworking and tactful in contact with customers. The activities that take place in direct relation with the user are reduced to: customer access, demonstration services, overcoming any obstacles, contracting, monitoring of service and development of cooperation.

Besides the practical value for development of its own marketing concept, the space of postal service units can have significant commercial value since it can be made available to other advertisers, as well as to the government and government authorities (taking into account the number of customers that visit postal network units during the day and territorial coverage at the national level). Traditionally close relationship between the national postal operator and the government and its improvement provide timely access to certain information that can be of great importance for the further development. The decisions made by the national authorities often have crucial consequences on the economic development of certain subjects, so the communication with the state should be given special importance. Better positioning on the market is certainly more likely to be achieved if notifications concerning certain legal provisions or guidelines for future economic development can be achieved timely.

A postal operator as public service is expected to bring closer the organs of local administration or government authorities, and these expectations will be fulfilled within the public role. On one hand, important data will be provided for customers on their local level (announcements, advertisements, lines of public transport, traffic congestion, weather information, water level forecast, service information, cultural events, opening hours for upcoming holidays, etc.), and on the other hand data relating to the entire territory of the country (cultural events, road conditions, weather forecasts, congestion at border crossings, activities and campaigns of individual department, marking national holidays, etc.). The next stage could be related to the outsourcing of certain activities from local and government authorities. During the process of waiting for the service realization, customers could be able to use a mobile application for electronic download of certain forms. After filling in the form, it could be sent back to the appropriate authority. An opportunity for outsourcing is also an opportunity for the postal operator to use the resources more efficiently, and for administrations to reduce the costs of their operation by giving a chance to the postal operator, as an institution of trust, to realize some of their activities.

5. CONCLUSION

The national postal operators in many countries are going through a difficult period of transformation as a consequence of transition from a monopoly position to a state of complete liberalization of their environment. The experiences of postal administrations indicate that considerable resources are invested to develop postal network units at a high level. Besides investing in the exterior and interior elements of postal units (in order to provide customers with a more comfortable environment while waiting), investments are also made in technology in order to reduce work activities in contact with customers to the smallest possible period of time.

The situation in terms of queuing at postal network units is implemented either through the queue barrier or the absence of any mechanism of control (customers respect the FIFO rule or give way to vulnerable categories of customers). In order to improve the customers experience during the process of waiting for the service realization, the possibilities of postal units as advertising channels are observed.

The implementation of the queue management system with tickets, where LCD monitors are used, although it requires a significant initial investment, can achieve all the goals that are set in front of it. That approach in postal network units creates an environment that contributes to a better position of postal operators on the advertising market. Pillars on which such orientation is based are: the promotion of its own range of services, the public role of the postal operators, the commercial role for third parties and the impact on the subjective perception of time.

REFERENCES

Baker, J., Parasuraman, A., Grewa, D., & Voss G.B. (2002). The Influence of Multiple Store Environment Cues on Perceived Merchandise Value and Patronage Intentions. Journal of Marketing, 66 (2), 120–141. doi:10.1509/jmkg.66.2.120.18470

Barrett, L. F., & Russell, J. A. (1999). The structure of current affect controversies and emerging consensus. Current Directions in Psychological Science, 8(1), 10-14. doi:10.1111/1467-8721.00003

Bauer, C., Dohmen, P., & Strauss, C. (2011). Interactive Digital Signage-An Innovative Service and Its Future Strategies. In Emerging Intelligent Data and Web Technologies (EIDWT), 2011 International Conference on IEEE, 137-142.

Beyer, G., Mayer, C., Kroiss, C., & Schröder, A. (2009). Person Aware Advertising Displays: Emotional, Cognitive, Physical Adaptation Capabilities for Contact Exploitation. In Proceedings of 1st Workshop on Pervasive Advertising at Pervasive 2009, Nara, Japan.

Chien, S.Y., & Lin, Y.T. (2015). The effects of the service environment on perceived waiting time and emotions. Human Factors and Ergonomics in Manufacturing & Service Industries, 25(3), 319-328. doi:10.1002/hfm.20542

Cutlip, S.M., Center, A.H., & Broom, G.M. (2000). Effective public relations (8th Edition Upper Saddle River, NJ: Prentice Hall.

Durrande-Moreau, A. (1999). Waiting for service: ten years of empirical research International Journal of Service Industry Management, Vol. 10 No. 2, 1999, 171-189. doi: 10.1108/09564239910264334

Goodwin, C., Smith, K.L. & Verhage, B.J. (1991). An Equity Model of Consumer Response to Waiting Time. Journal of Consumer Satisfaction, Dissatisfaction, and Complaining Behavior, 4, 129-138.

Grgurović, B. (2011). Segmentacija tržišta u funkciji unapređenja tržišta usluga u poštanskom saobraćaju. Saobraćajni fakultet, Beograd.

Hui, M.K., Dube L., & Chebat J.C. (1997). The impact of music on consumers' reactions to waiting for services. Journal of Retailing, 73(1), 87–104. doi:10.1016/S0022-4359(97)90016-6

Kelsen, K. (2010). Unleashing the Power of Digital Signage. Focal Press Media Technology Professional.

Maister, D. (1985). The Psychology of Waiting Lines. In Czepiel J.A., Solomon M.R., Surprenant C. (Eds), The Service Encounter, Lexington Books, D.C. Heath and Co., Lexington, MA

Marion, F., & Berengen, P. (2004). Empatija i alhemija istraživanja u oglasnim spotovima. Psihologija u marketingu. Clio, Beograd.

Mehrabian, A., & Russell, J. (1974). An approach to environmental psychology. Cambridge, MA: MIT Press.

Müller, J., Exeler, J., Buzeck, M., & Krüger, A. (2009). Reflectivesigns: Digital signs that adapt to audience attention. In Pervasive computing. Springer Berlin Heidelberg, 17-24. doi: 10.1007/978-3-642-01516-8_3

Post of Serbia. (2015). Retrieved from http://www.posta.rs/struktura/lat/marketing/oglasavanje-posta.asp

Pruyn, A., & Smidts, A. (1998). Effects of waiting on the satisfaction with the service: Beyond objective time measures. International Journal of Research in Marketing, 15 (4), 321–334. doi:10.1016/S0167-8116(98)00008-1

Schaeffler, J.(2008). Digital Signage: Software, Networks, Advertising, and Displays: A Primer for Understanding the Business. Focal Press.

Taylor, S.E., Wayment, H.A., & Carillo, M. (1996). Social Comparison, Self Regulation, and Motivation, in Handbook of Motivation and Cognition. ed. Richard M. Sorrentino and E. Tory Higgins, New York: Guilford, 3–27.

Tsiros, M., & Mittal, V. (2000). Regret: A Model of its Antecedents and Consequences in Consumer Decision Making, Journal of Consumer Research, 26, 401-417. doi:10.1086/209571

Voorhees, C.M., Baker, J., Bourdeau, B.L., Brocato, E.D., & Cronin, J.J. (2009). It Depends Moderating the Relationships Among Perceived Waiting Time, Anger, and Regret. Journal of Service Research, 12(2), 138-155. doi:10.1177/1094670509336744

Zhou, R., & Soman, D. (2003). Looking Back: Exploring the Psychology of Queuing and the Effect of the Number of People Behind. Journal of Consumer Research, 29 (4), 517-530. doi:10.1086/346247

OPTIMIZATION OF LOCAL MEDIA BUSINESS IN THE CONDITIONS OF TURBULENT ENVIRONMENT

Dalibor Bubnjević*[1]
[1] NIP „Zrenjanin“ a.d. Zrenjanin,
*Corresponding author, e-mail: daliborbzr@sbb.rs

Abstract: *The local media are facing strong competition, educated and self-aware audience in the choice of content. As a result of technical, economic, social, cultural and global convergence, it leads to the founding of new communications paradigm. New media which appear do not reverse the previous but rather unite their characteristics. The survival of journalism at the threshold of the information society is based on the creation of a broad portfolio of media products and multiplatform expertise of staff which need to win over a large number of audiences. The fact is that citizen journalism is gaining in importance thanks to the possibilities offered by the Internet. However, some theorists predict the survival of professional journalism at the local level, as new media technologies are not acceptable for all layers.*

Keywords*: marketing, local media, optimization, business environment, strategy*

1. INTRODUCTION

The means of mass communication have existed for about 150 years. All this time the **media's mission** has not changed: providing the public with *complete and accurate reports* on all public matters and *mediation in expressing opinions*. Today the media are *engine of globalization* and often *determinant of the organization's life of the individual*. The degree of their development in a country is conditioned by a number of factors: economic wealth, the achieved level of technological achievements, scope and schedule of the audience, political system, cultural environment, etc. The media industry is very similar to the function of research and development (R & D) in the other branches: a necessary technological sophisticated equipment and skills, retains the character of the labor-intensive activities, the marginal cost of acquiring a new customer is low, however, the need to develop economies of scale.

Today, **the media public** is *more educated and self-conscious in choosing content*, and journalism reserves the traditional role in society (Milivojević, 2012):
[1] The collection, selection and formation of conscience that are of importance to the public debate (gatekeeping role);
[2] Definition of issues of public interest (agenda setting role);
[3] Saving Democracy (watchdog role);
Above all, journalism is searching for its new identity in a coordinate system that is formed by the logic of speed, brevity, competition and superficiality.

The print media are in an *unenviable position* due to *the technology they apply*. "Newspapers have long been the fastest mass medium. Advances in technology and, above all, taking the primacy of audio-visual media have made the newspapers come by little into the background" (Bulatović and Bulatović, 2009, p. 29). *Readership is declining*, especially among young people, due to changes in lifestyle (for example, flexible working hours). Advertisers are increasingly opting for *advertising on the Internet* (particularly in the field of real estate). The number of specialized websites that allow presentation of content on more attractive and less expensive manner is increasing on the global network. Taking into account the facts enumerated, it is not surprising that some theorists predict an apocalyptic end of the press!

However, there are numerous **advantages of print media** (Bulatović and Bulatović, 2009): 1) *more thoroughly (more interpretative) coverage* of people and events, taking into account all aspects; 2) readers achieve *better control over the elements of news* by opting for articles that are more relevant to them / hold their attention; 3) daily disclosure of *important information for the life of the community* – people born, married or died, promotional campaigns, etc.

In the new millennium, so-called general readers, who are interested in a wide range of topics (from the world news, through the national to local), is increasingly declining. "One thing is quite certain, and that is that the press in its new guise, or online edition, can integrate all the traditional media, and therefore

becomes a participant in the most important competition in its centuries-long history" (Ugrinić, 2012, p. 88). This conclusion is the result of the realization that **the new media does not reverse the previous one**, but rather *consolidates its features*.

The influence of information and communication technology has led to **the transformation of journalism** into **the media business**. It is *a mature market* in which the information is no longer viewed as a commodity but as a service that has a limited time value. The goal is to find the optimal business concept to charge it. Changes occur in (Stamenković, 2015): 1) the method of distribution of content - the chain of production is being shortened, thanks to social networks, 2) media content - anyone can create information ("social activism"), 3) production. As a result of technical, economic, social, cultural and global convergence, it leads to the founding of *new communications paradigm*. Modern technology does not impose a specific editorial policy but, above all, influences decisively on journalistic practice and organization of the newsroom.

Technological determinants influence **the change of use of the media** and modification of **the structure of the media content**. Two groups coexist (Milojević and Ugrinić, 2011): 1) *technological enthusiasts* – who are ready to face the changes, show an interest in learning new technology, believe in the progressive potential of new media; 2) *technological skeptics* – who are traditionally oriented, express opposition to the adoption of new technologies and trends, seeking to preserve the existing professional methods.

The Internet as a meta-media has enabled a drastic increase in the number of participants in the public dialogue (debate). Consequently, the media *have lost their right of priority in the public sphere* and *are no longer the only privileged producer* of public information. The business model on which the industry they belong is founded, is coming to the collapse, and the profession is at a crossroads. "Many problems in the traditional media, from political pressures and ever growing influence of economic power centers to ever more difficult working conditions and financial situation in which journalists are, media professionals are forced to seek new business models in order to survive in the media sphere" (Stamenković, 2015, p. 845). In response to the new circumstances, **the concept of entrepreneurial journalism** has been developed in the United States. The increase of productivity, efficiency and profitability is required. The emphasis is on economy of scale, analysis of competition and the potential for further development.

The survival of journalism at the threshold of the information society is based on *the creation of a broad portfolio of media products* and *multiplatform expertise of staff* which needs to win over a large number of audiences. New professions in the media sphere are created, such as the organizer of content (*content curation*). Journalists and editors are no longer considered in isolation in relation to the media business. They are expected to think about the advertisers. Requirements for achieving the (positive) financial results and the need for editorial freedom create **systemic conflict**!

2. PARTICULARITIES OF LOCAL MEDIA BUSINESS

The famous saying "Life is global, living is local" most graphically explains **the cause of survival of the local media**! "The Future Foundation" has concluded that the daily activities of individuals occur (on average) at a distance of 22.54 kilometers: distance from work - 13,04 km, distance to the store - 6.11 km. Radius of movement of elderly people and women and men with low income is less than the average (Aldridge, 2007)! The connection with the place of residence is based on convenience life and feelings (sentiments). Owing to the above, the need local news has developed. It is particularly evident during the aging process of an individual.

Commercial local media are an important factor in informing the community. Many regard them as guardians of indigenous identity! Hence it is not surprising that *public attaches great attention to them*. For example, in 2005 the UK's readership of local / regional media was higher than the followers of national daily newspapers. France and Canada recorded a similar trend, ie. regional media dominate. In the new millennium, they are faced with the emergence of web journalism, the development of digital platforms and multimedia services, unwillingness of advertisers for pay for advertising via global network. Due to *financial difficulties,* they are often not in a position to transform and progress technologically. "The situation is such that they are trying to cope with unfair competition and survive in the market by using different strategies: some of them see the way out of the unfavorable economic situation in the help of the state and the others in the development of advertising via the Internet and e-business" (Krstić, 2012, p. 118). Regardless of the approach that they choose, the media managers are aware that if they do not adapt to changes in the environment, there is little chance for survival between Scylla and Haridb of the new millennium media market.

The advantages of the local media are:

- *They are part of the community* – they are formed as a testing ground for answering questions that are of importance to the daily life of an average citizen (local exclusivity and deep research of news background). "The main reason for the continuation of the popularity of local media is in their ability to capture and celebrate the life of the community "(Aldridge, 2007, p. 29);
- *They realize direct contact with readers* - reporters "live with them";
- *The audience is defined at the level of locality* - advertisers are aware of the above facts and therefore use them to publish job ads, advertisements for local products / services, etc .;
- *The level of freedom* (moral) *is higher*,
- *The ability to diversify content*- editorial is facing a complex challenge, because it needs to adapt content to different demographic groups.

They are considered to be **the need of democratic society**, because it is the place where local democracy takes place! Although located in the center of the culture of professional journalism, *they are often ignored* by the public and the academic community.

The process of digitization provides the technical basis for *further localization of news* and, at the same time, *intensifying competition* in the battle for the favor of the audience. In recent years there has been a **consolidation of the local media market** in most developed countries, which is characterized by: non-appearance *of new actors*, the absence of *divestment*, earning *profits*. In mid-2005 in the United Kingdom, the key publishers in the relevant segment realized the profit rate of 28% to 30%. To survive in stagnant and declining industries, *active and aggressive management* is necessary. Companies are opting for various business strategies:

- *Rationalization of assets* - centralization of administration (for example, departments of Human Resources and Marketing) changes in the role of editors, etc.;
- *Reducing the cost of employees*;
- *Economy of collection and use of content* - the use of *citizen journalism*;
- *Creation of multiple and targeted content*.

The development of inexpensive printing technologies at the end of the twentieth century largely contributed to the proliferation of **local press**! "They are intended for informing local community and are very popular in their environment. Small groups of people regulate and prepare them, they are cheap and usually financed by the local community" (Bulatović and Bulatović, 2009, p. 35). They act independently or as part of the media group. In the countries of the European Union regional and local newspapers are increasingly dominant in relation to the national! Readers are becoming saturated by global issues and increasingly give attention to the events and the people in their environment. Regional newspapers are *different from supplements* in national publications (they have a different concept, greater freedom in the choice of topics, familiarity with readers, fewer barriers, etc.).

Local press has to be *reactive, reflexive and non-profiled*. It has *a limited shelf life* (from one day to several weeks) and *the limited number of potential customers* (who live in a particular geographic area). Consequently, logistical issues are becoming important. Readers are heterogeneous, increasingly *seen as customers / consumers* rather than as citizens with rights and responsibilities in the public sphere. *Primary target groups* are individuals older than 50 and residents who are in the process of forming a family. It is insisted on *maintaining contact with the audience*(for example, the publication of positive and micro local news). Volunteer journalists are becoming more important (*volunteer community correspondents*).

The future of local newspapers will largely be determined by the attitude of the audience formed towards the mass communication media. The fact is that *citizen journalism* is gaining in importance thanks to the possibilities offered by the Internet. However, some theorists predict *the survival of professional journalism at the local level*, as new media technologies are not acceptable for all layers. Some social groups question the quality and credibility of the information given by the amateurs on the global network, since they do not possess the necessary knowledge and skills to perform a very responsible job. That target group actually pays attention to reporting on local issues in an analytical and in-depth way!

3. BUSINESS ENVIRONMENT

Variability is immanent for the business **environment**. At one stage in the company's development, the environment may be *more inclined to management*, while at certain moments dangers dominate in relation to opportunities and thus prevent the realization of the set goals. Some authors associate state in the business environment with the phase of the life cycle of the branches. As a rule, the environment is stable in the early stages, but later becomes restless (Pokrajčić, 2009). "Ansof also states that the environment can be classified according to the degree of restlessness and he proposed five levels: stable, reactive, forward-

looking, exploring and creative. Factors relating to this restlessness are measures of strategic activities, such as investment in research and development, predictability and frequency of changes, new changes and the company's ability to transfer previous experience, level of knowledge for successful responses and applicability of technology predictions" (Flečer, 2003).
In the newly created atmosphere (the recession, the expansion of digital media, hyper-competition, market fragmentation, etc.) there is a need to **change the method of doing business**. "The twenty-first century is said to be the century of changes. All economic entities and people must learn to adapt and change quickly and in a timely manner, or they will not be able to survive in the variable environment as it is today and what it will be in the foreseeable future" (Vujić, 2008, p. 17). Companies that are willing and able to *create value on the basis of socially responsible marketing* have higher chances of achieving market success, given that the interested public approves corporate action which is focused to increase social welfare.

Differentiation of *external and internal environment* is conducted in the literature. "Typically, the external environment is divided into **macro** and **micro marketing environment** and means the initial step in analyzing and formulating business opportunities of the company" (Milisavljević et. Al.,2004). *Macro marketing environment* affect the company's operations in an indirect and long-term way. Factors that determine the relational environment are beyond the control of management (demographic, economic, legal, political, cultural environment, etc.). Changes in the macro-marketing environment can be systematic (which are, as a rule, sustained and predictable) and irregular (random). *Micro marketing environment* directly affects business performance achieved by companies. It is about organizations and individuals with whom the business entity comes into contact (competitors, customers, suppliers and intermediaries). **ETOP**matrix (Environmental Threat and Opportunity Profile) is often used for the analysis of the macro environment, as well as **PEST (E)** analysis (Pokrajčić, 2009). In continuation, the attention will be paid to PEST (E) analysis of the general environment of the media industry in Serbia. We will focus on understanding the political / legal (P), economic (E), social / cultural (S), technological (T) and environmental factors (E).

Table 1*:* PEST analysis of the general environment of businesses in the media industry

Political/Legal factors	**Economic factors**
1. Law on Public Information and Media	1. High unemployment
2. Law on Business Companies	2. Low purchasing power
3. The restrictive fiscal policy	3. Recession
4. Amendments to the Labour Law	4. Unfavorable trends in GDP
5. Inconsistent judicial practice	5. High interest rates
6. Frequent elections	6. Reduced budgets for advertising
Social/cultural factors	**Technological factors**
1. Depopulation	1. Small investment in R & D
2. Uneven distribution of income	2. Insufficient focus of the state and the industry to new technologies
3. Changes in lifestyle	3. The lack of new discoveries
4. The attitude towards work and leisure time	4. Low speed of technology transfer
5. Consumerism	5. Application of outdated technologies
6. Low level of education	

According to IREX's Media Sustainability Index, which recorded a *minimal improvement* over the previous period (unsustainable mixed system),**Serbia is in the group of unsustainable systems.** The transition of the media market from the post-communist into liberal has been implementing in a slow pace. "The slow adoption of laws and their slow or lack of implementation, lack of support of the state apparatus and the like - no matter how paradoxical, make Serbia attractive for all kinds of risky investments" (Bulatović and Bulatović, 2009, p. 35). *The sales of printed media are declining* and the *pressure from advertisers is increasing*. Yearly income from advertising in media in Serbia is between 150 and 160 million euros. "Journalists at the local level are particularly exposed to the unpredictability of local politicians who can interfere with the activities of journalists" (EUROPE & EURASIA MEDIA SUSTAINABILITY INDEX, 2015). Collecting information from branches of republican bodies acting in the local community is more difficult.

The company must look at the immediate neighborhood by applying sophisticated techniques. **SWOT analysis** is the most common instrument used for the purpose of exploiting opportunities in the region and the benefits of the company, ie. avoiding risks and improving the shortcomings. A precise analysis of *the level of attractiveness and the probability of realizing opportunities ie.severity and probability of overcoming danger* is required. "Based on the analysis of opportunities and threats the company is able to identify four possible outcomes in business: ideal business (big chances – small risk), speculative business (big chances-high risks), mature business (small chances-small risk) and problematic business (small chances-high risks)" (Milisavljević et. al., 2004). SWOT analysis should allow *consideration and determination of the relevance of marketing trends* in the macro environment, as well as to contribute to *a precise projection* of these long term trends. As a result, the available opportunities will be used and the risk will be avoided by the implementation of the necessary redesign within the organization in order to determine the area of operation management.The process of strategic management becomes important in conditions of the crisis, as the basis of its three key elements for survival in turbulent conditions of the environment - *strategic analysis, strategic choice* and *strategy implementation*. More specifically, after defining the vision and mission of the company, a thorough analysis and forecasting environment and internal capabilities is needed. Based on available data the objectives, critical success factors and concrete strategic options will be defined. In the last step, the strategy will be implemented, and then controls and audits will be executed.

4. STRATEGIES IN THE MEDIA INDUSTRY

There have been great discussions on the topic - how can companies, in the most painless way, pass between Scylla and Haridb which are accompanied by the turbulent business conditions? The opinions are mainly positioned in two ways. On the one hand there is **a school of thought** that advocates rationalization, ie. savings in order to increase business efficiency (*reactive approach*). Another group of businessmen and theorists emphasize a *proactive* approach to the problem and highlights the planning of process management. We believe that that division is too radical for the newly formed business environment and actually represent the subject of theoretical discussion more than the alternative solution to a particular problem.

Even one company, that exclusively adapts to the status quo in the form of a sort of incremental march, trying to base their success solely on cost reduction, can not survive on the market. Similarly, the so-called unilateral application of proactive approach would have resulted in a low probability of business success for most businesses, because it is unrealistic to expect that a significant number of individuals due to personal ingenuity flourish, rather than competition, to seize the opportunity posed by the business environment. **The optimal model of management** these days is actually *a combination of the two approaches*. From businesses, particularly in the media industry, almost impossible business scenarios are expected. It should not be surprising, since, in troubled times, the most effective effects are achieved by implementing a seemingly controversial strategy.

The literature increasingly states so-called **entrepreneurial approach** of copying with changes in the environment, which is based on *the exploitation of chances and internal resources* of the company. In the first step, the company is trying to observe the extent to which the assets and capabilities at its disposal are unique, valuable and prone to imitation. This is a critical point, because only on the basis of that analysis, the company can objectively examine the challenges in the business environment that can be used. In the next iteration, using Porter's value chain, *ways of achieving added value* are identified. Source of market power can be either in the primary or in the so-called support activities.

In the new circumstances, it is possible to achieve a competitive advantage **by combining simultaneously a number of activities** in which the company achieves superiority in relation to market opponents. For the company in the recessionary period, *existing customers* are *the most important assets*. It is unrealistic to expect that, during the plunge in living standards and the fall of gross domestic product, classic marketing tools will succeed in gaining a new audience or advertisers. Existing customers of media content and advertising space must be met adequately by delivering superior value.

Strategic marketing is certainly a perfect weapon that is available to the media. "Key issues in strategic marketing are: whether a company should perform existing tasks, which are the products and markets of special importance for the survival, growth and development of companies, which new products and markets to look for and how to find those where it is possible to achieve a certain different or competitive advantage with respect to the potential of the company" (Milisavljević, 2006, p. 30). Consequently, all products, services, activities, resources and individuals are *subject to (pre)testing* in order to eliminate "idle" and the efficient and effective use of available resources. Regardless of the aggravating circumstances imposed by new constellation of forces in the region, any measures taken must be viewed in terms of consequences for

consumers, ie. users. The leaders of businesses should especially take into account the lump-saving actions, which may have far-reaching consequences - loss of customers. Strategic marketing therefore should provide a framework for the implementation of both internal and external analysis.

5. CONCLUSION

The twentieth century has created economic and technical-technological prerequisites for *a different way of life* of people in the community, but at the same time gave birth to the greatest *bloodletting* in human civilization. Hence it is not surprising that Eric Hobsbawm called it the "century of extremes". "This is the century in which the capital with liberal democracy has turned itself into ... neoliberalism of globalized economy for whom politics, morality and law, whether national or international, have no autonomy, but are functionally set as a mere service logos of globalized capital personified in profit "(Balj, 2009, p. 252). Some theorists (Pepper, Fukuyama, Giddens et al.) consider neo-liberalism, which is based on the free market and democracy, as the best political and social system, while on the other hand, critics point out that the new order annulled the man as a political being and instead produced a man as a consumer.

Almost no one expected the recession in the first decade of **the new millennium**! Today, many are trying to determine the real causes and consequences of the same. The fact is that the collapse of the global economic system was not only caused by economic but also numerous social failures (the crisis of the value system, greed, etc.). Therefore, managers will have to devote more and more attention in the future to the analysis of macro environment in order to be able to predict a new "social-economic tectonic disturbances" some extent, which will affect the competitive position of the company which they lead.

Companies that choose to fulfill their mission in the conditions of **complex environment** are faced with numerous *legal, economic, political and social challenges*. Each of these challenges will have certain implications on the business policy of the company. It is far more difficult to predict demand in the complex environment. Consideration of planned decisions must be implemented through the prism of analysis of *exchange rate fluctuations* and other macroeconomic aggregates (such as inflation). Companies must take into account the *infrastructure problems* that may be encountered (for example, the absence of press outlets in certain urban areas).

The economic and media crisis, which swept across Serbia as "tsunami", should not only represent a limitation in achieving the set goals of planning of the company, but also a challenge. In business, the above mentioned business strategies present a possible dike to protect the local / regional media from overflowing threats in the environment and their own weakness. In conditions of the crisis, *additional caution* is required, as there is a reasonable risk of bankruptcy of the business which the media cooperate with. Therefore, fair and open cooperation of all partners involved in delivering superior value to customers is more necessary today. In times of economic crisis, there is no right to make mistakes!

REFERENCES

Aldridge, M. (2007).*Understanding the Local Media*. Maidenhead, UK: Open University Press.

Balj, B. (2009). Duh vremena i poslovni moral.*Arhe*, Vol. 6 (11), 247-257.

Bobera, D. (2008). Project Management Organization.*Management Information Systems*, Vol. 3 (1), 3-9.

Bobera, D. (2008). *Projektni menadžment*. Subotica, Srbija: Ekonomski fakultet u Subotici.

Bogetić, Z. (2007). *Menadžment kategorije proizvoda*. Beograd, Srbija: Data status i Ekonomski fakultet u Beogradu.

Bulatović, G., & Bulatović, Lj. (2009).*Masovni mediji*. Novi Sad, Srbija: Cekom.

Fernandez, J. (2009). The 10 commandments for the modern marketer.*Marketing Week* 15 October 2009, 18-22.

Fleček, K. (2003). *Upravljanje marketingom i informaciona tehnologija*. Beograd, Srbija: Clio.

Grubor, A. (2012). Segmentacija, targetiranje i pozicioniranje u globalnom marketingu.*Anali Ekonomskog fakulteta u Subotici*, Vol. 48, 28/2012, 123-131.

Đuričin, D. (2003).*Upravljanje (pomoću) projekata*. Beograd, Srbija: Ekonomski fakultet u Beogradu.

Kotler, F., & Trias de Bes, F. (2005).*Lateralnimarketing: tehnike za iznalaženje novih marketing ideja*. Novi Sad, Srbija: Adizes.

Krstić, A. (2012). Novinarstvo i medijska industrija u Srbiji: profesionalni dobitak, ekonomski gubitak. *CM*, broj 24, godina VII 1, 115-132.

Milisavljević, M., Maričić, B., & Gligorijević, M. (2004).*Osnovi marketinga*. Beograd, Srbija: Ekonomski fakultet u Beogradu.

Milisavljević, M. (2006).*Strategijski marketing*. Beograd: Ekonomski fakultet u Beogradu.

Milivojević, S. (2012). Uvod: novinarstvo za informaciono društvo, *CM*, Broj 24, godina VII 1, 29-34.

Milojević, A., & Ugrinić, A. (2011).Spremnost novinarske zajednice u Srbiji za tehnološke promene.*Verodostojnost medija: dometi medijske tranzicije*. Beograd, Srbija: Fakultet političkih nauka i Čigoja štampa, 133-153.

Pokrajčić, D. (2009). Položaj preduzeća u promenljivom okruženju.*Ekonomoska politika Srbije u 2009.godini i izazovi svetske ekonomske krize*. Beograd, Srbija: Ekonomski fakultet u Beogradu: Str. 109-123.

Stamenković, S. (2015).Novinarstvo i mediji budućnosti – kreiranje identiteta i stvarnosti.*MediaS Res*, Vol. 4, br. 6, 838-858.

Sudarević, T. (2011).Viralni marketing u sklopu Web 2.0 marketing strategije.*Novi metodi menadžmenta i marketinga u podizanju konkurentnosti srpske privrede*. Beograd, Srbija: Ekonomski fakultet u Beogradu.

Todorović, J., Đuričin, D., & Janošević, S. (2000). *Strategijski menadžment*. Beograd, Srbija: Institut za tržišna istraživanja.

Ugrinić, A. (2012). Novinarstvo i medijska industrija u Srbiji: izazovi za profesiju u štampanim javnim glasilima. *CM*, broj 24, godina VII 1, 75-92.

Vujić, V. (2008).*Menadžment promjena*. Opatija, Hrvatska: Fakultet za turistički i hotelski menadžment.

„EUROPE & EURASIA MEDIA SUSTAINABILITY INDEX 2015“ (2015). Retrived from http://www.irex.org/sites/default/files/2015-msi-serbia.pdf, pristup 30.08.2015.godine.

GASTRONOMIC FESTIVALS AS A FORM OF BRANDING SERBIA AS A TOURIST DESTINATION

Milena Vukic*[1], Marija Kuzmanovic[2], KsenijaVukic[2]
[1]Hospitality and Tourism School, Belgrade
[2]University of Belgrade, Faculty of Organizational Sciences
*Corresponding author, e-mail: milena.vukic12@gmail.com

Abstract: *Gastronomy represents a form of social interaction which is increasingly attributed significance by tourism destinations. The gastronomic offer of Serbia is a fusion cuisine which integrates not only cuisines of neighbouring countries but of the entire Balkans as well. Considering the rich cultural and historical heritage of Serbia, organizing a food festival would represent a creation of new sources of branding, as well as a source of economic development based on innovative means of creating a holistic experience.A better understanding of the attitudes of gastronomic tourists may help tourism marketers to increase the effectiveness of their branding strategies by creating an adequate offer to appropriate market segments. The findings of the study offer insights not only to food festival organizers but also to the national tourism organization for success in destination marketing. Also, the analysis of the obtained results may lead to the conclusion that food festivals can play an important role for destination branding.*

Keywords*:food tourism, destination branding,festivals,Serbiangastronomy*

1. INTRODUCTION

Challenges which arise from rapid global changes and issues arising from economy restructuring, more and more lead to the fact that destinations base their positioning strategy on their own resources such as culture, history, gastronomy and other anthropogenic values. Creation and promotion of festivals and events is nowadays a crucial branding strategy component of many tourist destinations.

With an increasing role of food in tourism, many researchers devoted themselves to researching the connection between food and certain tourist destinations, tourism and food, culinary tourism and gastronomic tourism. According to Santich(Santich, 2004), gastronomic tourismis every journey whose motivation, even if it is not the main motivation, is tasting food and beverages. This author also points out that gastronomic tourism refers to the involvement in another culture especially the part which involves food, beverages, people and places.

Food consumption was treated for a long time only as a supplement to the daily experience of tourists and its role as an invisible part of daily tourism activities for a long time has created a problem of acceptance of gastronomic tourism where its character and contribution to tourism is considered to have little importance. Very small number of works investigated events dedicated to food. Hjalager and Corigliano (2000) found that availability of specific types of food, including wine, fruit, vegetables, and fish was the reason to organize festivals and events that tourists and local population will like.

Events, festivals, fairs, exhibitions, events, complement tourism portfolio of a country by enabling ways for non-elastic tourist offer elements to be flexible and offer a unique experience that can increase value of current image of a country. Main characteristics of the events are the following: limited duration, occur rarely or only once, offering social experience, they are unusual, raising awareness of the region, creating a positive image and attract tourists and thus affect the development of tourism in general (Bodwin et al., 2007).

Within the tourist offer of Serbia, event tourism is a type of tourism that can contribute to increasing volume of tourist demand, especially to natural and anthropogenic values of tourist places or regions (Bjelac and Curcic, 2007). Event tourism first appeared in the strategy of tourism in Serbia in 2006, where this form of tourism was seen as a significant global market potential which contributes to the return of Serbia to the world market. Many tourist destinations use their food and cuisine to position themselves in the tourist market.

Extensive literature in the field of festivals and other events identify that festivals are being used as a means of destination branding (Chalip and Costa, 2005).

There are several factors which can influence the creation of a positive perception of these events both with existing and potential visitors. First, positive impressions from gastronomic festivals can be transferred to the entire tourist region which can influence future visits as well as purchase of gastronomic products. Gastronomic festivals can influence creation of consumers' awareness of brands they did not know of. Awareness can further influence visitors to prefer brands they know more about. These manifestations also provide an opportunity for gastronomic producers to educate visitors, because only educated and well-informed visitors are prepared to buy premium gastro products (Vukic et al., 2015)

In addition, food festivals are used to promote local commodities and differentiate themselves from metropolitan community festivals (Cela et al., 2007; Sharples, 2008).

The objective of this study is to investigate attitudes of tourists when it comes to gastronomic events in Serbia as well as to outline possibility of branding Serbia as a culinary destination. Although it is considered that food festivals are an opportunity to promote local gastronomic products, it is considered they would be a good opportunity to connect the entire region of South East Europe through creating regional food festivals.

2. THE GASTRONOMIC PRODUCT OF SERBIA AS A DESTINATION BRAND

In the past few decades, growing competition in tourist destinations has led to the development of more appealing attractions that will occupy the attention of potential tourists. Some countries opt for an integrated product branding of the country as a tourist destination, while others see their opportunity in branding partial tourism products. For a tourist destination, the brand is very important because it represents more than products and services, as it includes trust and emotions. A destination becomes a brand only if it is permeated with high values. According to Morrison and Anderson (2002), destination branding is the process used to develop a unique identity and personality that is different from all competitive destinations. As state or city brands reflect a part of a national brand, regional brands reflect specific regional branding under the overall umbrella of a state brand (Crockett and Wood, 1999).

Events are part of the attraction of a destination and as such should be included in the integrated marketing campaign for the destination and incorporated into a destination's branding strategy (Jago et al., 2003).A large number of authors has studied festivals as a way of branding destinations (Derrett, 2003; Jagoet al., 2003; Kim and Morrsion, 2005; Lee and Lee, 2009); however, only a small number of them has dealt with food festivals (Arcodia and Lee, 2008) as a means of branding.

Even though there is no natural or automatic harmony or synergy between events and other products offered in a destination (Fyall and Garrod, 2005), food is one of the few products in which a clear link between gastronomy and destination brand can be seen. Hjalager and Richards (2002) stated that tasting local food is an essential part of the tourism experience since it can serve as both a cultural activity and entertainment. Telfer and Wall (2000) suggested that spending on eating out during a holiday constitutes approximately one-third of all tourist expenditures.

In Serbia, there is a large number of traditional events, local manifestations, festivals, celebrations, et al. In addition to being popular in the domestic market, some of these events have the potential for the international market where they have so far reached a certain degree of popularity (Tourism Strategy of the Republic of Serbia, 2005). Even though event tourism was recognized in the Strategy of Tourism Development of Serbia in 2006 as a form of tourism that can increase the volume of tourist demand, in comparison with other destinations which significantly use food as a way of positioning, Serbia has not sufficiently used its potentials, especially if we bear in mind that its authentic cuisine is rich and unique.

To create a culinary brand is not easy, but there are huge benefits to it. First of all, customers save their time when choosing between different brands and instead of considering all possible options, the brand encourages customers to take into consideration only those products which possess the required characteristics. For brand strategy to be successful and useful in creating a brand value, consumers must be convinced that there are clear differences between brands in a category of products. The importance of creating a culinary festival is to indicate what might be the significance of the production of private brands of food on the performance of the company itself together with the economy of the whole country as well as neighboring countries.

Besides the authenticity of the cuisine of Serbia, culinary knowledge and skills were influenced by other nations and cuisines. Depending on the region, these impacts can be reduced to the Ottoman Empire, i.e. Turkish cuisine, the Austro-Hungarian cuisine as well as modern Italian cuisine, whose biggest impact was in the coastal regions of the former Yugoslavia. The cultural and culinary influences are intermingled, creating a new fusion cuisine of the Balkans where everyone participated so much that now everyone has the right and claim over the same product.

Even though the term Balkans, as a geographical region of Europe, is nowadays slowly being replaced by the term Southeast Europe, when appearing in the global market, the term "Balkan food region" could achieve greater recognition and authenticity. The reason for this is a rich cultural and historical heritage as well as the previously mentioned culinary influences, which is why it is possible to link the whole Balkan region as a unique gastronomic destination, and place it under the name of "Balkan food region", in order to achieve recognition in the international market. This approach to branding represents an alternative opportunity for tourism development in the whole region, particularly because food festivals, rather than other types of festivals, are one of the common types of regional festivals (Kalkstein-Silkes et al., 2008).

3. ATTITUDES OF VISITORS TO GASTRONOMIC TOURISM

In order to examine attitudes of visitors to gastronomic tourism (gastronomic manifestations) in Serbia, a research was conducted in the period between February and July 2014. The sample was composed of 431 respondents, with an average age of 24.94 (SD = 9.39), where the youngest respondent was 15, and the oldest was 63 years old. From the total number of respondents, more than a half were women (54.8%), while 45.2% were men. When it comes to monthly income, there were an equal number of respondents whose monthly incomes were between 20,000 RSD and 40,000 RSD and between 40,000 RSD and 80,000 RSD. There were 19% of respondents with incomes below 20,000 RSD, 10.9% with incomes between 80,000 and 160,000 dinars, whereas only 2.9% of respondents had monthly incomes higher than 160,000 dinars. As far as the employment status is concerned, the largest number of respondents were university students (36.4%), 29.5% were high school students, 28.5% were employed, 4.4% were unemployed, whereas the number of the retired was the smallest (1.2%).

Besides questions related to demographic data, the questionnaire also contained questions concerning the respondents' attitudes to gastronomic tourism, which referred to the frequency of visits, the state of being informed as well as reasons for not visiting gastronomic manifestations. From the total number of respondents, the survey showed that almost a half of respondents (207 respondents) were familiar with the term gastronomic and culinary tourism. 108 (27%) of them were not sure what this form of tourism represents, while 116 respondents (26.9%) had never heard of this form of tourist movement (Figure 1).

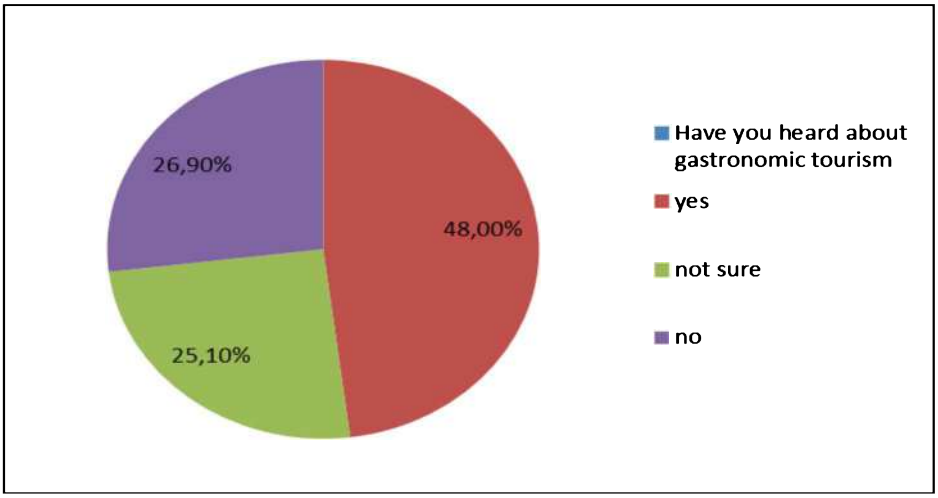


Figure 1: Awareness of gastronomic tourism

Regarding the frequency of visits, only 12 respondents (2.8%) visit these forms of manifestations several times of year, 187 respondents (43.4%) visits them occasionally, whereas the largest number of respondents, more precisely 232 (53.8%), never visit gastronomic manifestations (Figure 2).

The respondents gave reasons why they rarely or never visit gastronomic manifestations, where they were able to choose one or more reasons, but they could also choose not to name one. 392 respondents named

the total of 451 reasons, whereas 39 respondents, mostly those who occasionally visit gastronomic manifestations (32 of them), did not give a reason.

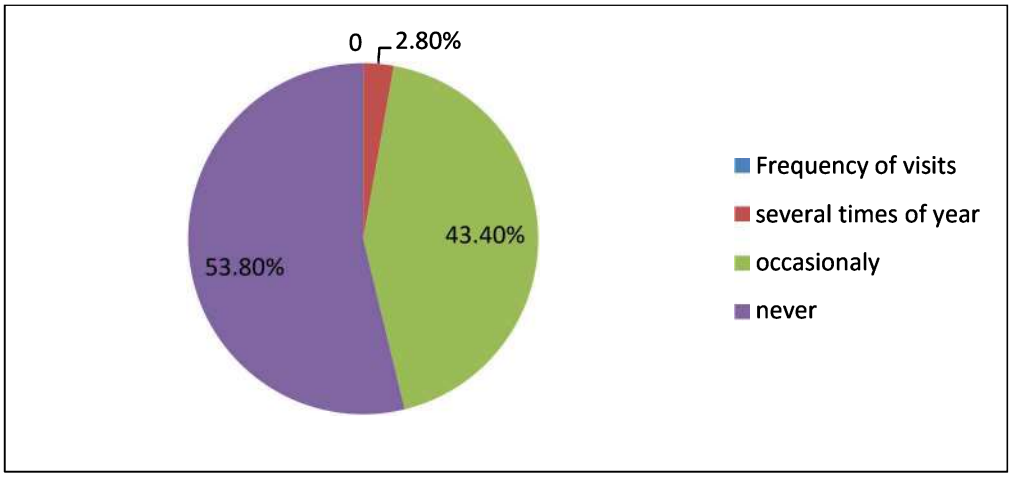


Figure 2: Frequency of visits

The analysis of answers given by the respondents (see Figure 3) have shown that the reason which is most often chosen is insufficient information, even 220 of them (51%) chose this as the only reason. Many respondents besides insufficient information stated other reasons as well such as financial reasons, the lack of free time and other reasons; therefore we may conclude that this group contains very few respondents who are not at all interested in gastronomic tourism. This also points to one of the biggest problems for marketing experts, and that is to ensure that potential consumers are informed and that they will remember their products and services.

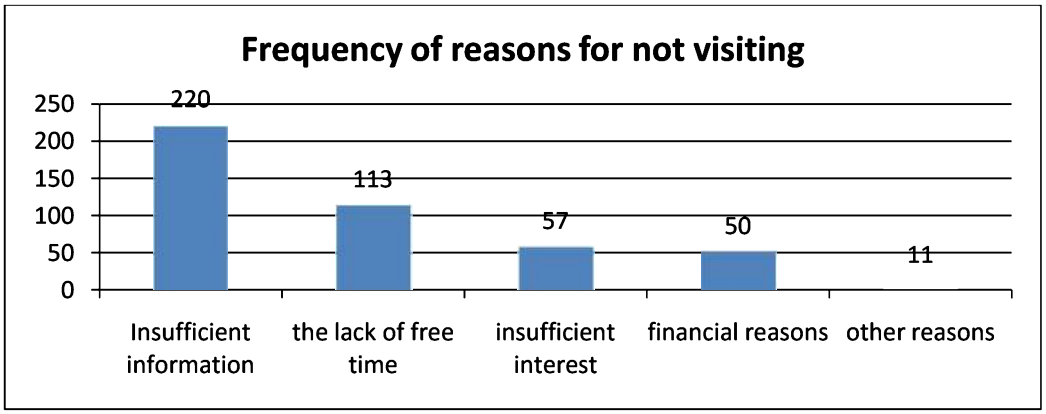


Figure 3: Reasons for not visiting gastronomic festivals

At first glance, one can say that a solution to this problem lies in the domain of planning and conducting the economic advertizing; however, the problem is more complex and we should start from a fact that it takes more than previous knowledge and understanding of a way consumers in tourism can be informed about tourism products in order to be well positioned in the tourism market. In the process of informing the consumers, both of its components, i.e. sensory and conceptual systems should be comprised (Maričić, 2008). The sensory system refers to the functioning of sensory receptors (senses) and marketing experts should strive to activate all five senses in order to influence a consumer's behaviour, although they might opt for selective approach as well. The conceptual system refers to mental processes and thoughts and considerations and it takes place when a consumer wishes to understand the meaning of a stimulus in their environment. This part of information process enables a creation of new knowledge, meanings and beliefs regarding the stimuli they are exposed to.

The second reason why the respondents rarely or never visit gastronomic manifestations is a lack of free time, where 113 respondents (26.2%) chose this as one of the reasons, and 60 respondents (13.9%) chose it as the only reason. It is very important to bear in mind that the very need for travel tourism is not sufficient for its realization, but what is also important is a possibility to manage free time as well as free funds as objective factors of forming a tourism demand. Even though working hours were even 12 to 14 hours a day in the early stages of capitalism, the situation has dramatically changed in the past 150 years, so tourism has obtained a dimension of "leisure time" industry. However, this research has shown that the turbulent times

Serbia went through nevertheless had an effect on tourism demand and that there is a considerable amount of those who are left with little free time available.

The lack of interest as a reason for not visiting gastronomic manifestations was chosen by 57 respondents (13.2%), whereas only 36 respondents (8.3%) were absolutely not interested, while others stated that they are either uninformed or lack financial means, so we may conclude that it is possible to create interest of these respondents if they are well informed.

Free funds, in addition to leisure and motive are still one of the drivers of tourist movements and can be an objective obstacle in meeting tourism needs. The research has shown that 50 respondents (11.6%) do not visit gastronomic festivals for financial reasons, of which 20 (4.6%) chose finances as the only reason. However, with the growth of income, the propensity to consumption increases as well and vice versa. In particular, it is known that an increase in income leads to a decrease in the share of expenditures for food and an increase in the share of expenditure for meeting the needs of a higher order (education, recreation, travel, etc.).

This interdependence was first studied by Engel in 1857 and formulated in the form of four laws on consumption (Maričić, 2008); therefore it can be said that Engel's laws also reflect consumer habits of today's customers, who spend much more on nights out, travel and other services and products of a higher order. Considering all these facts, there is a possibility that an increase of financial funds with these consumers pours into service activities and that they change from potential to real visitors of gastronomic manifestations. Other reasons were chosen by 11 respondents (2.6%), whereas 46 respondents (10.7%) did not know the reason for not visiting these forms of manifestations.

According to the answer to the question about how frequently they visit gastronomic manifestations, a statistically significant difference between male and female respondents was noticed (sig = 0.009). Namely, out of 12 respondents who frequently visit gastronomic manifestations, even 10 were men. The largest number of respondents who never visit this kind of events are women (59%), whereas the number of men and women who occasionally go to gastronomic manifestations is almost the same. Therefore, it can be concluded that the gender affects visits and that men more frequently visit this kind of manifestations (Table 1).

Table 1: The results of comparing the frequency of visits with the respondents' gender

Question:	**How often do you visit gastronomic festivals?**				
Gender		Often	Never	Occasionally	Total
	Female	2	137	97	236
	Male	10	95	90	195
Total		12	232	187	431

By cross-referencing data on the education of respondents and the frequency of visits, we can see that there are significant differences in visiting gastronomic manifestations depending on the level of education (sig = 0.000). It can be seen that out of 12 respondents who often visit gastronomic manifestations, three (25%) have a high school diploma. On the other hand, 8 respondents (67%) who often visit gastronomic manifestations have a college degree, and the smallest number of respondents who visit manifestations have a university degree (8%).

From the total number of respondents who never go to these manifestations, 51 of them (22%) have finished elementary school, 67 respondents (29%) have a high school diploma, 16 respondents (7%) have finished college, 84 respondents (36%) have a university degree, and 14 (6%) have a master's degree . The analysis of the respondents who occasionally visit gastronomic manifestations has shown that 43 respondents (23%) have finished only elementary school, 38 respondents (20%) have a high school diploma, 31 respondents (17%) have finished college, 56 respondents (30%) have a university degree, whereas there is only 1% of respondents with a PhD.; however, the 1% is comprised of the only 2 respondents in the entire sample who own a doctorate. Table 2 indicates that gastronomic manifestations are most often visited by respondents with a college degree, that respondents who occasionally visit them are university graduates or own a doctorate, and those who never visit these manifestations are mostly university graduates (Table 2).

The following analysis refers to respondents who never visit gastronomic manifestations and the reasons leading to this. From the total of 232 respondents who never visit gastronomic manifestations, only 11 respondents (4.74%) chose finances as a reason. The lack of free time was given as a reason by 39 (16.8%) respondents, whereas 20 respondents (8.6%) did not know the reason why they do not visit these manifestations. One of the reasons for 48 respondents (20.69%) was not being interested.

Table 2: The results of comparing the frequency of visiting manifestations with the level of respondents' education

Question:	**How often do you visit gastronomic festivals?**				
Education level		Often	Never	Occasionally	Total
	Elementary school	0	51	43	94
	High school	3	67	38	108
	College	8	16	31	55
	University	1	84	56	141
	Magister, Master	0	14	17	31
	Doctorate	0	0	2	2
Total		12	232	187	431

However, what could be interesting for potential planners of this kind of manifestations is that the largest number of respondents, 102 (44%), to be more precise, who never visit such manifestations said that insufficient information was one of the reasons for it.

4. CONCLUSION

Today, organizing festivals with different content represents a unique opportunity for tourists to experience leisure, social and cultural experiences but they are also a generator of economic development of a destination. Since food is important component of attractiveness and image of a destination, organizing food festivals can only add value to the overall tourism product. Tradition of food festivals is very long and this type of tourism is even recognized as one of future trends of tourism development in Serbia.

The results of this research showed that although more than half of the participants are familiar with the concept of culinary tourism, only a small number of them visit these events several times a year while more than half of them do not visit them. Such a small number may not be a significant indicator of the possibilities of branding Serbia as a gastronomic destination due to its great gastronomic heritage. This thesis can also be demonstrated through results from the answer to the question why they seldom or never attend this type of events. Most of them stated the reason of not visiting is insufficient level of information that indicates the need to create a clear and consistent marketing on strategies designed for this type of tourism.

When creating marketing strategy of gastronomic festivals, interests of larger and smaller segments or market niches should be taken into account. Serbia as a gastronomic destination can position itself as a competitor compared to countries in the region. However, it is possible that new events for competition with other countries, encounter a situation to cope with current events at home. Having in mind these circumstances, one of possible positioning strategies could be based on collaborative marketing across the region, launching "Balkan food region" as a destination brand. Better coordination of an event calendar would help to avoid rivalry among regional events and create cooperative marketing activities because gastronomic events in Serbia have a gastronomic tradition of its population in the territory of Serbia (Serbian, Montenegrin, Croatian, Bosnian Hungarian, Romanian, etc.).

The positioning of Serbia as a gastronomic destination implies the existence of a quality gastronomic product, a design of a communication strategy that would make a gastronomic product become recognized by tourists whoprefer it to other competing destinations. Branding this form of tourism means communicating values, mission and vision to tourists.

REFERENCES

Arcodia, C., & Lee, I. (2008). The role of regional food festivals for destination branding:A critical review of the literature. Paper presented at the *Global events congress III*, Guangzhou, China

Bjelac, Ž.,&Ćurčić, N. (2007). Tourist manifestations in the region of ZapadnoPomoravlje.Bulletin of the Serbian geographical society, 87(2).*inSerbian*

Bodwin, G., Allen, J., O'Toole, W., Harris, R., & McDonnell, I. (2007). *Events Management*, Butterworth andHeinemann, Oxford

Cela, A., Knowles-Lankford, J., &Lankford, S. (2007). Localfood festivals in Northeast Iowa communities: avisitor and economic impact study. *ManagingLeisure,*12, 171–186.

Chalip, L., Costa, C. (2005). Sport event tourism andthe destination brand: towards a general theory.*Sport in Society*, 8(2), 218–237.

Crockett, S.R., Wood, L.J. (1999). Brand WesternAustralia: a totally integrated approach to destinationbranding. *Journal of VacationMarketing,*5, 276–289.

Derrett, R. (2003). Festivals and regional destinations: how festivals demonstrate a sense of community and place. *Rural Society*, 13(1), 35-53.
Fyall, A., &Garrod, B. (2005).*Tourism marketing: Acollaborativeapproach*, Clevedon:Channel View Publications.
Hjalager, A.M. &Corigliano, M.A. (2000).Food for tourists-Determinants of an image. International Journal of Tourism Research Volume 2(4), 281–293.
Jago, L., Chalip, L., Brown, G., Mules, T., & Ali, S. (2003). Building events into destinationbranding: insights from experts.*Event Management*, 8(1), 3-14.
Kalkstein-Silkes, C., Cai, L.A., Lehto, X.Y. (2008). Conceptualizing festival-based culinary tourism inrural destinations. In *Food and Wine* Festivals *andEventsAroundtheWorld*, Hall CM, Sharples L (eds). Butterworth-Heinemann: Oxford; 65–77.
Kim, S. S., &Morrsion, A. M. (2005). Change of images of South Korea among foreigntourists after the 2002 FIFA World Cup.*TourismManagement*, 26(2), 233-247.
Lee, I., & Lee, T. J. (2009). The success factors of using events in destination branding: Acase study of Woodford Folk Festival. Paper presented at the *8thAsianPacific forum for graduate students research in tourism,* Seoul*,* Korea*.*
Maričić, B. (2008). *Behaviourof consumers*, Savremenaadministracija, Belgrade.*inSerbian*
Morrison, A. M., Anderson, D. J. (2002). Destination branding, Paper presented at the*MissouriAssociationofConvention*&*VisitorBureausAnnualMeeting*, June 10.
Santich, B. (2004). The study of gastronomy and its relevance to hospitality education and training.*InternationalJournalofHospitalityManagement* 23(1): 15–24.
Sharples, L. (2008). Apples, cider and celebration. In*FoodandWineFestivalsandEventsAroundtheWorld*, Hall C.M., Sharples L (eds). Butterworth-Heinemann: Oxford; 134–145.
The strategy of tourism of the Republic of Serbia, The first phase report..(2005),.Horwat Consulting, Zagreb, Faculty of Economics, Belgrade, Ministry of Trade, Tourism and Telecommunication of the Republic of Serbia. Retrieved from http://www.dgt.uns.ac.rs/download/ektur01.pdf*inSerbian*
Vukic, M., Kuzmanovic, M., Martic, M., Mihajlovic D., &Kostic-Stankovic, M. (2015). Preferences of consumers towards food festivals: Empirical study.Paper presented at *34thInternational*Conference*onOrganizationalScienceDevelopment*, Portoroz, Slovenija, 1294-1305

MARKETING AND SUSTAINABLE DEVELOPMENT

Marija Jovic*[1], Branka Novčić[1]
[1]Univerzity of Belgrade, Faculty of Organizational Sciences
*Corresponding author, e-mail: marijaj@fon.rs

Abstract: *The concept of sustainable development has become a widely used catchphrase in contemporary organizations .This concept is nowadays central to the programs of many government and non-government organizations, as well as in many businesses around the world. Still, scientific literature lacks a thorough and encompassing explanation of this concept through a variety of scientific disciplines and areas of business. This article aims to contribute to the literature in the field of marketing and sustainable development for understanding and effective implementation of this concept in real environment. Sustainable development refers to satisfying needs of people, without compromising the ability of future generations to satisfy their own needs. Here, marketing plays an important role, not only through the alignment of the company's strategy with the environment, but also through the promotion of the importance of the application of this concept.*

Keywords*: sustainable development, sustainable marketing, sustainable customers, sustainable products, sustainable market*

1. INTRODUCTION

Sustainable development, as a relatively new and evolving area of theory and business, can be considered an emerging concept. Accordingly, sustainable development concept is continuously changing in relation to local contexts, needs and interests. However, there still exists a lack of a thorough and encompassing explanation of this concept through a variety of scientific disciplines and areas of business. On the other hand, there are several things which academic community mostly agrees on. First, the question is no longer about contradiction of development and environmental concerns. The question is how sustainable development can be achieved, while phrase “sustainable development” has become pervasive (Lele, 1991). This phrase is becoming more common as a topic of conferences, as a slogan of environmental activists, or development planers (Lele, 1991). Second, describing the sustainable development concept, most researchers point to its three main pillars in society: economic, ecological and social (Dyllick & Hockerts, 2002; Holling, 2001). Third, the solution of the problems of sustainable development is one of the priorities for national governments, global companies, and all forward thinking people of the world.

So far, a lot of papers have been written on this topic, but authors still do not agree on the definition of this concept. Moreover, some authors believe that there is no need for a universal definition and that the value of this concept lies precisely in its ambiguity (Lele, 1991). According to some authors, the vagueness of the definition of sustainable development enables people who have had opposing views to jointly find a solution for the definition of this concept through a debate. The lack of a harmonized definition of the concept of sustainable development hinders the application of this concept in practice.

The basic elements of the complex problem of sustainable development are poverty and harmful impact of excessive consumption of the rich population on the environment. At the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro in 1992, the governments of the member countries of the United Nations highlighted the need to focus international and national policies of countries in such a way that the impact on environment should be discussed when making any economic decisions. This message has contributed to the principle of eco-efficiency to become one of the guiding principles not only in companies, but also in government institutions. For example, different modes of production, especially the production of toxic substances, such as lead in gasoline, or poisonous waste, are under both the UN (United Nations) and governments scrutiny; they seek to replace fossil fuels, associated with global climate change, with alternative sources of energy; they seek to develop public transport systems in cities, in order to reduce the pollution resulting from the emissions from vehicles (UNCED, 1992).

With increasing modern society awareness of the importance of sustainable development, an area that can be called sustainable marketing is also developing. The importance of sustainable marketing for sustainable development can be seen in the fact that there is a significant part of marketing theory which is related to the promotion of new ideas and consumer behaviour. In particular, marketing should make a significant

contribution towards overcoming the gap between the already confirmed fact that consumers care about social and environmental issues and their influence, which is often contrary to the interests of the environment.

As a contribution to the development of marketing and sustainable development, this paper analyses the concepts of sustainable development and marketing theory and practice that can be linked with this concept. Specifically, after a review of the key elements of the concept of sustainable development, a variety of marketing strategies and tactics that could contribute to the development and popularization of the concept and contribute as much as possible to its application in practice have been considered.

2. SUSTAINABLE DEVELOPMENT

Sustainable development, as a relatively new concept, was created as a result of understanding of people's harmful effects on their environment. This concept has been seriously accepted after the United Nations Conference on the Human Environment in Stockholm in 1972. Apparent climate changes, which present response of nature to harmful effects of people, contributed a lot to understanding the importance of this concept.

Sustainable development has been defined in many ways so far. The definition that perhaps best describes the essence of the concept of sustainability is one that was given by Brundtland (1987) "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs ". This definition is not precise enough (Lele, 1991), but it illustrates two fundamental problems related to environmental degradation that accompanies economic growth, as well as the need for such growth, in order to reduce the level of poverty (Adams, 2006). Also, Martin and Schouten (2012) described sustainability as the ability of the system to continuously maintain or renew itself, pointing to an important feature of this concept, where the system is inevitably changing, and it is not preserved or kept in a static form.

The essence of modern theories of sustainable development is the notion that there are three dimensions of the concept: environmental, social and economic (Adams, 2006; Dyllick&Hockerts, 2002) (Figure 1). From the environmental standpoint, sustainable development should enable integrity of the natural environment as well as unhindered development and change. In doing so, the point is not to preserve and keep the system in a static state in which it loses its biodiversity, but to enable it to smoothly reproduce and adjust to various changes.

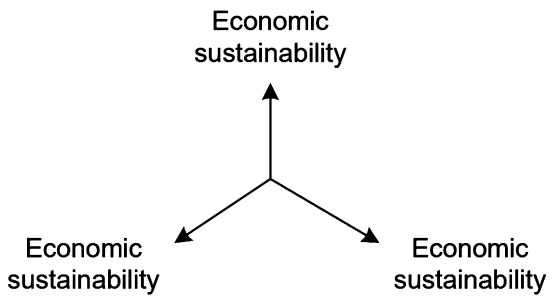


Figure 1: Dimensions of sustainable development (Dyllick & Hockerts, 2002)

The social dimension is focused on human development, maintaining the stability of the social system and preventing social conflicts. A human being should be an active participant in development, through the management of his/her life. An important prerequisite for this is a fairer distribution of resources between people i.e. reduction of the so-called GINI-index, as well as tolerance among people and preservation of cultural heritage.

The economic dimension refers to the optimal use of limited natural resources, as well as development of technologies that will achieve better energy savings. The essence of the economic dimension is to ensure the growth and to achieve the efficiency.

Each of these three dimensions should be optimized in relation to itself, and also in relation to the other two dimensions (Meier & Magas, 2014). Coordinating these three dimensions of sustainable development is a very complex task. In terms of socio-environmental relation, it is necessary to preserve the ability of future generations to use natural resources that are available to today's population. When it comes to socio-economic relation, it is necessary to achieve a better distribution of wealth among people. Economic-

environmental relation requires constant alignment of the cost with the impact of technology on the environment.

The solution of the problems of sustainable development is one of the priorities for national governments, global companies, and all forward thinking people of the world. Today, the majority of UN member states have ministers and departments in charge of the environment. In Serbia, this segment belongs to the competence of the Ministry of Agriculture and Environmental Protection. Also, as a body within the Ministry of Agriculture and Environmental Protection, Environmental Protection Agency performs expert tasks related to environmental protection, the development of an information system on the environment, as well as tasks related to cooperation with the European Environment Agency (EEA) and the European Environment information and Observation Network (EIONET) (EPA, 2016).

The Sustainable Society Foundation has developed Sustainable Society Index (SSI), which enables comparison of the level of sustainable development among different countries (SSF, 2014). This index integrates three dimensions of sustainable development, whose main goals are the welfare of mankind and environmental welfare. The economic welfare itself is not a goal, but it represents the means of achieving social and environmental benefits. The framework for the interpretation of this index is presented in Figure 2.

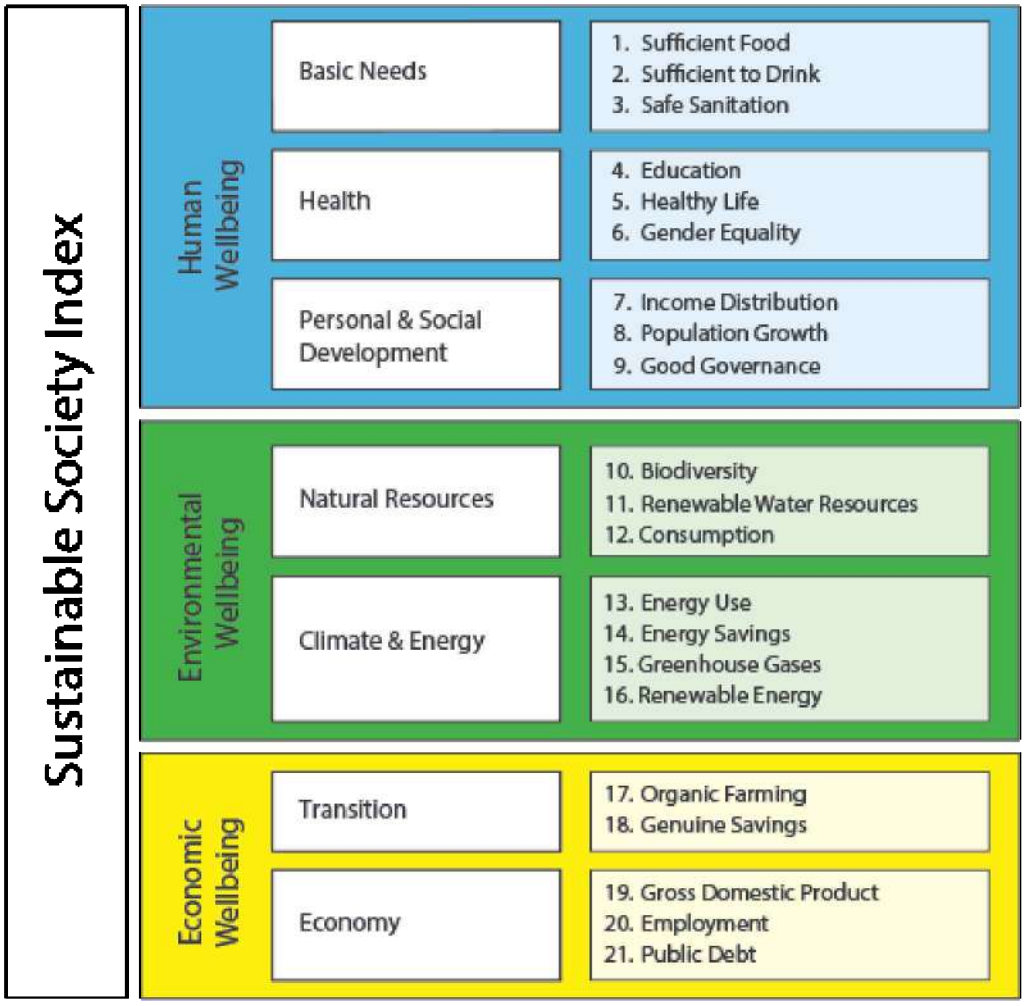


Figure 2: Framework for SSI (SSF, 2014)

According to this framework, out of the 151 countries in which SSI is being followed, Serbia is in 34th place in terms of the social welfare, in 60th place in terms of the environmental welfare and in 135th place in terms of the economic welfare (SSF, 2014). Viewed globally, social welfare occupied the highest level in 2014, which in the scale to 10 had a mark between 6 and 7, followed by ecological welfare with a mark between 4 and 5, whereas economic welfare had a slightly lower mark (SSF, 2014). On the other hand, in comparison to 2006, progress in the area of economic and social welfare can be noticed, while the environmental indicator is worse for a little more than 0.2 compared to 2006 (WSF, 2014). This indicates that despite the development of awareness of the importance of environmental conservation and protection, people are not ready to behave responsibly in this regard.

3. SUSTAINABLE MARKETING

The increasing demand and interest in the issue of sustainability have led to the expansion i.e. the development of the concept of marketing in the direction of sustainable marketing. Among the key drivers of sustainable marketing development there is customers' increasing awareness about the issue of sustainability, as well as the growing demand for "sustainable products, " possibility of gaining competitive advantage in the growing "sustainable market", as well as government regulations and various laws that encourage the adoption of the concept of sustainability.

Sustainable marketing is focused primarily on sustainable market that includes a growing number of companies, different products and services and of course customers, all of which are somewhat aware of, and take care of the problem of sustainability. The concept of sustainable marketing, in addition to the company's profits, also takes care of long-term environmental, social and economic effects of different activities. This approach represents a significant improvement in relation to traditional approach, which was focused mainly on the economic benefits of the company.

Bearing in mind the growing awareness of people about the issue of sustainability of 61% compared to 2012 (National Geographic, 2014), as well as a number of developed marketing tools used to change consumers' behaviour, a surprising fact is that consumers themselves continue to present a significant obstacle to the implementation of the concept of sustainability (The Guardian, 2016). Moreover, despite a growing awareness in key markets such as the US, Germany, Japan and China, sustainable purchasing behaviour has actually decreased compared to 2012 (National Geographic, 2014). Many authors have tried to find the reason for this "value-action" gap, where the majority came to the conclusion that although people attach importance to values such as sustainability, morality, ethics, etc. these values are not included in the consideration when purchasing.

Sustainable Lifestyles Frontier Group was founded with the intention to try to save the value-action gap that is present between attitudes about sustainability and behaviour when purchasing. One of the conclusions reached is that the problem is not in consumers' value system, but in the value that is offered to consumers (The Guardian, 2016). More specifically, customers are interested in the answer to the question what they get out of that. When creating a supply of sustainable products, in addition to general arguments which are related to the conservation of eco-systems and planets, it is necessary to include elements from a traditional marketing theory which are related to the offer of value to customers (Kotler& Armstrong, 2014). Three basic types of value that customers expect from products are functional, emotional and social value (Sweeney &Soutar, 2001). Thus, a sustainable product must keep relation value-money which customers are already accustomed to, must involve emotions of a buyer by offering him to feel better, smarter and more valuable, and also to understand that such behaviour will encounter a positive response from environment.

In practice, marketing campaigns related to sustainable products are mainly oriented to highlighting the social and planetary benefits, instead of the values which are of key importance to consumers (The Guardian, 2016). A good example in the food industry would be messages related to the health of customers with the absence of pesticides and other harmful substances that contribute to health and reduce the risk of various diseases or obesity in people, showing people what the benefits of sustainability are for them.

In addition, it should be noted that sustainable marketing at the same time contributes to building long-term customer relations. Given that relations are created when customers believe that they share the same value system with a company, it can be concluded that the idea of sustainability can be a value, which is common for customers and a company. However, to achieve this, it is necessary to, after the implementation of the concept of sustainability in the strategic orientation of the company, improve or develop a marketing mix that will also consistently support and transmit the idea of sustainability. The specific role of sustainable marketing in individual companies will vary in relation to the industry, size, corporate culture, as well as marketing management model, which can be customer-focused, technology-focused or communication-focused.

Within the implementation of the concept of sustainable marketing, the first objective is to create and increase the market for sustainable products and services, and identify and stimulate demand for sustainable products (Meler&Magas, 2014). Also, one of the important steps in the implementation of strategies for sustainable marketing is segmentation of sustainable market. This is followed by the implementation of the concept of sustainability into a company's marketing mix. In this regard, it is necessary to adapt products to the needs and desires of consumers, as well as to the criteria of environmental protection and sustainability. The prices of products must be formed on the correct level, which must be ethically suitable and acceptable both to a seller and a buyer. The distribution, as well as the price should be in line with good practice while respecting the principles of sustainability, transparency and accountability. Finally, the promotion should be

based on sound ethical and moral codes, providing wide, reliable, unambiguous and creatively adapted publicity related to environmental protection and sustainability (Meler&Magas, 2014).

All this points to the need for marketing to get out of the current framework and involve a wider concept of management which is focused on the production and delivery of sustainable solutions which would profitably meet the needs of consumers and other stakeholders.

4. CONCLUSION

Bearing in mind all that has been said so far, it can be concluded that the application of the concept of sustainable development in companies is becoming an increasingly important topic and one of the key strategic goals of business of an increasing number of companies. They do not question whether it is necessary to integrate the concept of sustainable development in business any more, but how this can be achieved. Although there are many good examples of applying the concept of sustainable development, it is impossible to make a universal model of its implementation. Each company, depending on the market in which it operates, its size, industrial sector, must develop an adequate strategy, whose leading aim will be to preserve the ecological environment and take care of the interests of society with the achievement of adequate economic results. Such sustainable strategy is focused on the future by meeting the needs of consumers and at the same time by achieving profitability for investors.

Based on current marketing theory and practice and specificity of the concept of sustainability and sustainable development, it can be concluded that the role of marketing in the implementation of the concept of sustainable development is important and versatile. First, marketing as a business segment that is closely connected to customers through market analysis, as well as through the creation of offers of values, must take into account the principles of sustainability when designing a marketing mix, as well as when building relationships with consumers. Also, marketing, with its extensive knowledge and experience regarding the customer behaviour and promotion of new ideas can significantly help to spread the idea of sustainable development and increase sustainable market. Finally, sustainable marketing, with its focus on social and environmental issues, can be considered one of the drivers of sustainable development because of its enormous potential initiating cultural change in society.

REFERENCES

Adams, W. M. (2006). *The Future of Sustainability: Re-thinking Environment and Development in the Twenty-first Century. tThe Future of Sustainability.* Gland, Switzerland. Retrieved from chrome-extension://oemmndcbldboiebfnladdacbdfmadadm/http://cmsdata.iucn.org/downloads/iucn_future_of_sustanability.pdf

AZZS. (2016). Agencija za zaštitu životne sredine. Retrieved from http://www.sepa.gov.rs/index.php?id=4&akcija=showAll

Brundtland, G. H. (1987). Our Common Future. *Oxford Paperbacks.* http://doi.org/10.2307/633499

Dyllick, T., & Hockerts, K. (2002). Beyond the business case for corporate sustainability. *Business Strategy and the Environment*, *11*(2), 130–141. http://doi.org/10.1002/bse.323

Holling, C. S. (2001). Understanding the complexity of economic, ecological, and social systems. *Ecosystems.* http://doi.org/10.1007/s10021-001-0101-5

Kotler, P., & Armstrong, G. (2014). *Principles of Marketing* (15th ed.). Pearson.

Lele, S. M. (1991). Sustainable Development: A Critical Review. *World Development*, *19*(6), 607–621. http://doi.org/10.1016/0305-750X(91)90197-P

Martin, D., & Schouten, J. (2012). *Sustainable Marketing.* New Jersey: Prentice Hall.

Meler, M., & Magaš, D. (2014). Sustainable Marketing for Sustainable Development. In *11th International Academic Conference Reykjavik*, 230–248.

National Geographic. (2014). *Greendex 2014: Consumer Choice and the Environment – A Worldwide Tracking Survey.* Retrieved from chrome-extension://oemmndcbldboiebfnladdacbdfmadadm/http://images.nationalgeographic.com/wpf/media-content/file/NGS_2014_Greendex_Highlights_FINAL-cb1411689730.pdf

SSF. (2014). Sustainable Society Index. Retrieved from http://www.ssfindex.com/ssi/

Sweeney, J., & Soutar, G. (2001). Consumer perceived value: the development of a multiple item scale. *Journal of Retailing*, *77*(2), 203–220. http://doi.org/10.1016/S0022-4359(01)00041-0

The Guardian. (2016). *The problem with sustainability marketing? Not enough me, me, me*. *The Guardian.* Retrieved from http://www.theguardian.com/sustainable-business/behavioural-insights/2015/mar/09/problem-sustainability-marketing-not-enough-me

UNCED. (1992). United Nations Conference on Environment & Development Rio de Janerio , Brazil , 3 to 14 June 1992. *Reproduction*, (June), 351. http://doi.org/10.1007/s11671-008-9208-3

SUSTAINABLE DEVELOPMENT OF STRATEGIC BRAND PARTNERSHIP

Slobodan Vasilic*[1], Dejana Milosev[1],
[1]Faculty of Organizational Sciences, Neoplanta a.d.
* Corresponding author, e-mail: milosevdejana88@gmail.com

Abstract: *Sustainability in marketing strategy not only helps in competitive advantage but also opens door for cost savings and innovation. When company achieve a brand partnership regarding sustainable development, that is a very good strategy for future. This paper presents a theoretical overview of strategical brand partnership and sustainable development. Also, this paper deals with understanding the concept of brand partnership and with understanding the process of building the strategic position and image of brands through the implementation of the concept of brand partnership within the strategy of integrated marketing communications. There are also two examples from practice and they presents sustainable development of strategic brand partnership. The first example is the example of strategic brand partnership of the companies TOTAL and Peugeot and the other one is the example of strategic brand partnership of the companies Unilever, PepsiCo and Coca-Cola. Both of these examples show their great cooperation where the companies combine their ideas and insights regarding main global challenges.*

Key words: *sustainability; development; strategic brand partnership; marketing; brand value*

1. INTRODUCTION

Strategic brand partnerships can be a very successful way to build serious business, boost brand awareness and walk into new attractive markets. Companies have been making partnerships for many times and for a variety of reasons and the whole point is that success of one brand will bring success to the other brand, its partner too. Brands partner for the visibility lift, increased exposure, attachment to other brand values, the anticipated revenue boost. Partnership can help or either hurt brand and brands in partnerships must be very cautious so they can access new targeted audiences and grow net new revenue. For good working partnership, it has to be a win-win game for all players in the game so target audiences, prices, value perceptions and promotion channels need to fit.

Successful brand partnership should bring measurable and high value to both companies, but they must combine each other value and deliver similar customer profiles. Also, the partnership must sit within the lifestyle and user experience of the customer.

The main advantage of strategic brand partnerships is in chance to produce the product that ensures to be at exclusive and powerful positions through the use of one or more other brands in the campaign. Partnerships can create more compelling points of differentiation and - or points equal to the brand, than would be possible without the partnership. As a result, partnership can generate higher sales than the existing target groups and to provide additional opportunities with new customers and sales channels. When we add responsibility for sustainable development in partnerships, that became a gold solution of modern world business.

2. WHEN TWO BECOME ONE: THE POWER OF STRATEGIC BRAND PARTNERSHIP

Consumers aren't looking so much for new brand thanks to brand loyality. They are on social networks that allow them to act „behind the scene" (i.e. Twitter, Facebook, Skype etc.). Consumers are creating brand stereotypes beacuse they like what others like on social networks without individuality. So brands reach new customers using other brands through partnership.

Today, brands may be linked to other entities in the minds of consumers have their own knowledge structure. Thanks to these connections, customers can assume or conclude that some associations that are characteristic of other entities may also be true for himself a brand that is associated with an entity. In other words, the brand "borrows" a brand knowledge and, depending on the nature of the association, a certain part of the brand values of the other entity.

This indirect approach to building brand value is called the use of secondary brand associations. Secondary brand associations can be important in creating a strong, appealing and associations of unique and positive customer response, if the existing association in some way insufficient. Also, the use of secondary brand associations can be an effective tool for strengthening the existing brand associations and responses of customers in a new and creative way. Connecting brands with another entity can create a new set of brand associations, but also could affect existing brand associations.

Creating a new brand associations: creating a link between the brand and the other entity, customers can form a mental connection from the brand to the other entity, and consequently to all associations, attitudes, feelings and likes that are related to that entity. This is important in situations where customers feel they do not have adequate knowledge to choose the brand or they do not care at all of that. In such situations, it is likely that the brand selection device based on consideration of secondary associations such as: what they think, feel or know the country of origin where the product / brand to come, stores in which the brand sales on behalf of the company that produces the brand or other characteristics.

Effects on existing brand knowledge: Linking the brand to another entities can affect the formation of new brand associations through the transfer from the entities to the same brand and also may affect the existing brand associations. Impact process is very ordinary. If consumers have some knowledge of the brand when the brand identify that is tied to another entity, customers can conclude that some specific associations, attitudes and emotions that characterize an entity also feature the brand. In other words, in the minds of consumers form an opinion that what is true for the property must be true for the brand.

The basic question to be answered, which is crucial for the success of the brand partnership and transfer of secondary association of other entities:
▪ What do customers know about the other entity?;
▪ Do you have the knowledge that the other entity in any way affects how will think of the brand when the brand in some way be connected to this entity?

Keller and Kotller (2012) point out that entities for which brands can bind with the aim of building the secondary brand associations:
• Company (through branding strategy);
• Member or other geographic areas (origin of the product);
• Distribution channels (through channel distribution strategy);
• Other brands (through co-brand);
• Characters (through licensing);
• Speakers (the recommendations);
• Events (through sponsorship);
• Other sources.

Best elements of brands are mixed into a partnerships. But there is also a risk where both parts need to solve a potential problems with negative attention. Because of the internal logistics not all partnerships are a good combination. It is estimated that about 80% of partnerships don't work successfully.
With the right partnership, the positive sides are obvious, starting with the access to an all new target audience, what is very important for both partners. Expectations of partnerships are to achieve:
▪ Better value proposition;
▪ Better visibility;
▪ Increased exposure to values (in partnerships with nonprofits);
▪ Solution to create exclusive products.

Keller and Kotller (2012) point out that three key important factors in predicting the degree of importance of linking the brand to the other entity are:

- Recognition and knowledge of the entity: If the entity is not well recognized and buyers have no knowledge of him, then the entity does not have anything that could be transferred to the brand. Ideally, customers should be aware of the existence of the entity; to have a strong, appealing and of unique assemblages related entities; to have positive attitudes and feelings related entities;
- What knowledge they have on the entity: If an entity causes some positive associations, attitudes and feelings, to be seen whether this knowledge is relevant and important for the brand. Some associations, attitudes or feelings may seem relevant and valued for the brand, while the other may have little to do with the brand;

- Portability knowledge of the entity: Refers to the question of how much of an association, attitudes or feelings that wears polarized entity (which could potentially be transferred to the brand) could strongly bind to the brand.

3. EVOLUTION OF SUSTAINABILITY IN MARKETING

Despite the different interpretations that can be found in the literature,this concept today has a central place in the consideration long-term prospects of survival and progress of mankind. Sustainability, or sustainable development, occurs both as an essential precondition, as well as the ultimate objective of efficient organization of numerous human activity on Earth.

Sustainable development is a concept where lives the idea that social, environmental, and economic growth are all achievable within the limits of our earth's natural resources.

It is important to meet all needs of the businesses and people but in the way of saving nature and life on our planet. One of many goals of sustainable development is to achieve business and social progress regarding saving natural resources. We owe to future generations to find a way of development that is good also for environments.

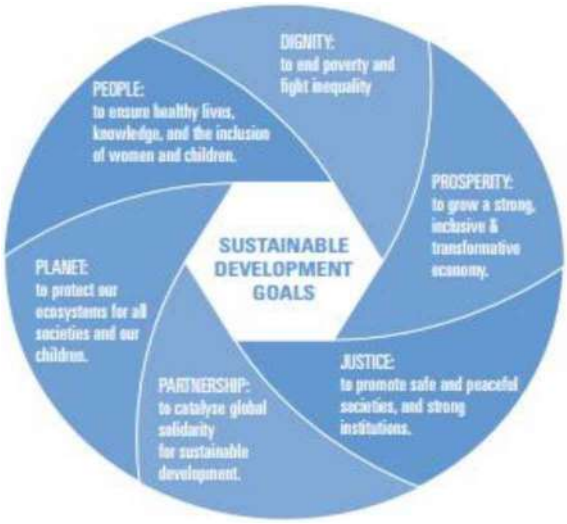


Figure 1: Six main parts for achieving the sustainable development goals (Charter, Peattie, Ottman and Polonsky, 2006)

In the past, it was believed that marketing and sustainability were almost opposite terms, since marketing was usually perceived as the promotion of more consumption while on the other side sustainability promoted less consumption. Marketers have to brake their traditional frame of reference to include sustainability in their marketing strategy. In some markets and companies sustainability issues have become highly important and a competitive factor influencing marketing strategies. Sustainability have three dimensions: environmental, social and economic and all three are very important.

Based on the above mentioned, companies needs to formulate the strategy so they can earned profits even after reduced impact on our society and environment.

Charter, Peattie, Ottman and Polonsky (2006) point out that the same is the case with sustainability marketing strategies i.e., if someone finds solutions for one environmental or social problem which is economically profitable, then a new set of problems also can arise out of that and this cycle goes on and on. Sustainability in marketing strategy not only helps in competitive advantage but also opens door for cost savings and innovation. It is rightly said that companies cannot stay for longer in the market if they will not become truly sustainable. But, there are limited companies which are trying to adopt sustainability in their marketing strategy. Moreover they are also having unsustainable products in the market.

In addition to this, Vinor, K., Zillur, M., Kazmi, A.,A., and Praaven, G. (2012) point out that the future goal of sustainability marketing strategy should be focused on segmentation, targeting and positioning customer on

the basis of sustainability criteria along with designing sustainability marketing mix for better products and services, better prices, better distribution and better promotion (p. 487).

4. SUSTAINABLE DEVELOPMENT OF STRATEGIC BRAND PARTNERSHIP

Companies are increasingly careful with whom they operate, so that in conditions of maximum transparency preserve its reputation. Therefore, as much as 95 percent of the 250 largest companies providing regular public reports on sustainable development.

Not all partnerships are well planned and successful but they has grown exponentially. There is many motives within companies for connecting with other company to achieve sustainability goals. Corporate social responsibility (CSR) is very important for all companies and they are looking at it as a chance to win and make a good brand with reducing their environmental footprint. Many researchers have proposed typologies or continua to capture differing levels of commitment by businesses to Sustainability or to partnerships designed to promote those ends.

Most continua had four levels, although some only had three, and a few had five. Austin and Seitanidi's (2012) proposal represented a synthesis of the four-part models, ranging from philanthropic to transactional to integrative to transformational.

Austin and Seitanidi's (2012) explained that achieving successful partnerships at the upper right of the continuum, in Figure 2, requires that partners learn to capitalize on the creative tensions inherent in the partnership. The different levels also help to distinguish partnership outcomes, with those focused on reputation and image in the bottom left and those with wider societal impact in the top right.

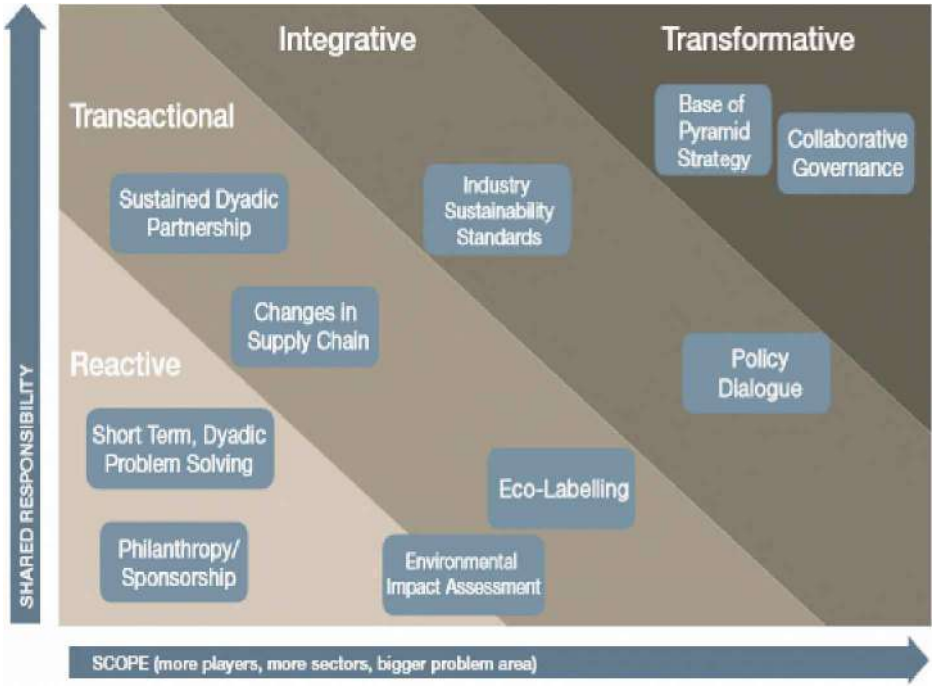


Figure 2: Sustainability Continuum (Austin and Seitanidi's ,2012)

Marrewijk and Werre (2003) explained that partnerships in the lower left-hand corner largely represent threat-induced, compliance or charity-driven responses. In this level of response, sustainability activities involve providing welfare to society by responding to government regulations or by providing charitable giving (p. 132).

The second level shows largely transactional sustainability partnerships, where the main reason for business is to make higher profit or better market share. The 3rd level captures integrative sustainability partnerships where businesses consider how to balance considerations with social and ecological concerns.

At the end, partnerships in the upper-right part in the Figure 2 shoes a final type in which other key stakeholders are involved in sustained interactions.

Young and Utting (2005) suggests that some do little, if anything, to advance the cause of sustainable development. Certain initiatives that are a form of eco-regulations can play, potentially, an important role in

promoting corporate social and environmental responsibility. Some so-called negotiated agreements, where government and business work together to design and implement programmes that retain the element of state sanction in case of non-compliance, have proved fairly effective. (p. 139-142).

5. SUSTAINABLE DEVELOPMENT OF STRATEGIC BRAND PARTNERSHIP IN PRACTICE - PEUGEOT AND TOTAL

TOTAL oils protects the engine from wear, transmit power and facilitate changing the transmission. Reaffirming its desire to be a leader in the domain of lubricants with high content of technology, innovative products Total brand are specially designed to save fuel (oil saving in fuel) , for the protection of the environment and improve the performance of every engine.

Oil products of brand TOTAL around the world tried out, tested and recommended by most manufacturers of cars - people who know what they're saying. In the United Kingdom, the company Total for Partners in the field of lubricants have chosen the leading car manufacturers like Peugeot, Citroen and Renault (it's Elf brand lubricants). They are perfect partners, because they all share a common ambition to be the best at all fields.

TOTAL and PEUGEOT are partners since 1995 and they renewed their partnership agreements recently. This renewal is not surprising , because the TOTAL lubricants are only brand to the French car manufacturer accepted at all, because they share the same goals. Researchers in companies TOTAL and PEUGEOT develop tomorrow's lubricants: oils which leads to less fuel consumption and thereby protect the environment and take fuel efficiency to better level. To further reduce their global CO2 footprint, their oil was developed with bio-sourced bases.

Main area of this partnership according sustainable development is: developing new engine lubricants and gearboxes, Total significantly contributed to reducing the TCO (Total Cost of Ownership), CO2 emissions, and fuel consumption by more than 7%.

TOTAL and PEUGEOT worked on an innovative project where the main theme was to secure future generations mobility that will be comfortable and energy efficient. They conceived lower CO_2 emissions (49 g/km).

This technological concept model uses the latest Peugeot and Total innovations in aerodynamics, weight saving and operating system. The performance of this concept can be achieved without the use of the main sources of energy, taking its base for highly energy-efficient production car model Peugeot 208. Achieving emissions of just 49 g/km and acceleration to 100 km/h in 8 seconds, then halved emissions at current most economical petrol engine, while at the same time receives motion of a small sports car that is fun and efficient. Accepting this technological challenge, the company Peugeot and Total as combining their research and development capacity to develop mobility solutions for future generations of cars. This car will have a special thermo-cycle management and improved fuel combustion, reducing friction engine components.

The result of engagement of company Peugeot is very positive, as the company has models with the lowest emissions in Europe, with an average reduction in emissions by 7 g/km on average 121 g/km in 2012. Total Group companies with their production parts (Lubricants, Fuels, Hutchinson, CCP Composites, Total Global Polymers) is actively involved in a number of Peugeot R&D projects to the production of new environmentally friendly vehicles.

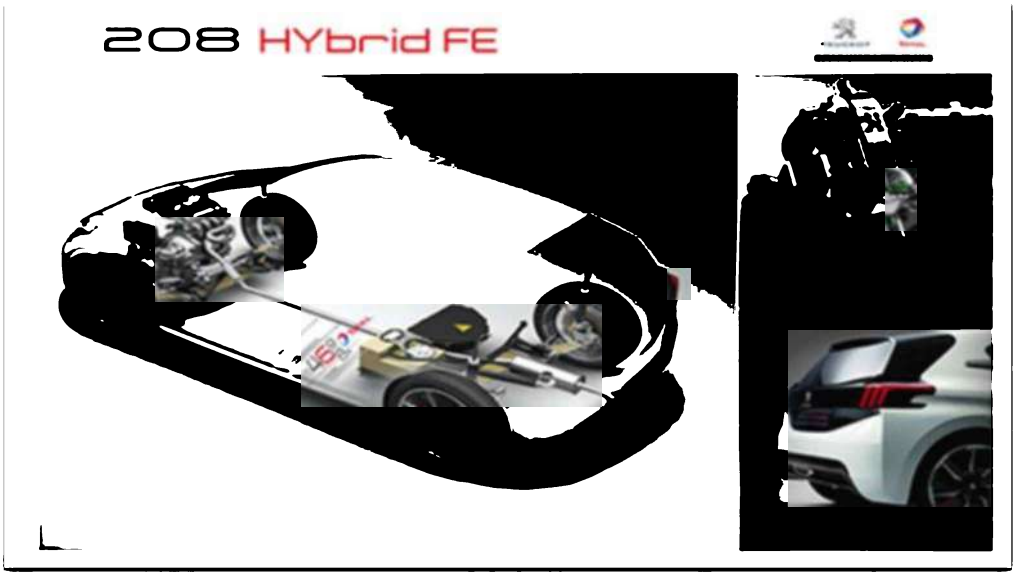


Figure 3: Peugeot new model Hybrid FE (www.peugeot.com)

6. SUSTAINABLE DEVELOPMENT OF STRATEGIC BRAND PARTNERSHIP IN PRACTICE - UNILEVER, PEPSICO AND COCA-COLA

Two months ago Unilever, PepsiCo, Coca-Cola and few more brands announced the cooperation where they combine their ideas and insights regarding main global challenges. This group performs under the name Paragon Partnerships, and wants to achieve the Sustainable Development Goals (SDG) through their collaboration and active market research.

With the United Nations Global Goals agreed and in motion, industry, governments and individuals can all play their part in contributing to the 17 point plan which aims to end poverty, combat climate change and fight injustice and inequality.

With no one single body or organisation able to find a solution to all of these challenges, Paragon has been created to be a single information source together with research bodies and industry.Launching in May this year, the vision for Paragon is to generate and provide access to quality insights on the issues that the world is facing which will help governments, academics and NGOs around the world. All insights hosted on the site will be linked to the Global Goals for Sustainable Development and will be available for Paragon partners to formulate fact-based programmes.Partners signed-up for launch include PepsiCo, Coca-Cola, Kantar, Nielsen, MetrixLab, GfK, Flamingo, Save The Children, The Market Research Society (MRS), Esomar and Sapient Nitro.Stan Sthanunathan, Senior Vice President, Consumer & Market Insights (2016, May 15).

Country clusters will segment the questions and it will be added to research conducted by the agencies for their clients during that quarter. The data will be hosted on a single platform to democratize the information and facilitate easy access; anyone signed up to the initiative Paragon will be able to access the company data.Through its research partners and their clients, Paragon expects to provide quality insights on the issues that the world is facing to allow governments, non-governmental organizations (NGOs) and academics to access and leverage that knowledge to help advance their work.

“In a rapidly-changing world, we cannot operate in silos. The past year has set the precedent with highly ambitious goals and frameworks created to address the global sustainability and development challenges that we all face. It is time to accelerate efforts to move towards achieving these goals and Paragon will allow us to share learning, data and insight, and encourages other businesses and industries to address these critical challenges affecting us all. By building a network of partners and working together, we can look for solutions which have greater scale and impact globally to address development and societal challenges”, said Stan Sthanunathan, Senior Vice President, Consumer & Market Insights at Unilever.

7. CONCLUSION

The strategic brand management have a main role in process of implementation sustainability in a company's main strategy and integration of the sustainability principles into all corporate parts. The imperative of sustainable business is not just a matter of altruism. It is primarily a question of the physical survival of companies in the world of limited resources. Adoption of a sustainable business model, together with other companies as partners, will enable them not only to survive in conditions of limited resources and more to long-term development.

Knowing that companies are increasingly careful with whom they operate, two cases from this paper showed great solution of modern world business and their partnership between some companies.

The first case showed the positive result of combining the research and development capacity to develop mobility solutions for future generations of cars. Peugeot has models with the lowest emissions in Europe, with an average reduction in emissions by 7 g/km on average 121 g/km in 2012. Total Group companies with their production parts (Lubricants, Fuels, Hutchinson, CCP Composites, Total Global Polymers) is actively involved in a number of Peugeot R&D projects to the production of new environmentally friendly vehicles. This case showed the great example of sustainable development of strategic brand partnership.

The second case testifies the definitive development of awareness and the importance of sustainable development of strategic brand partnership. The future will hopefully show the success fro of this network of partners under the name Paragon Partnership.

REFERENCES

Austin, J. E., and Seitanidi, M. M. (2012). *Collaborative value creation: A review of partnering between nonprofits and businesses: Value creation spectrum and collaboration stages.* Journal of Marketing, Vol. 2, Issue 5, 322-323.

Beisheim, M. (2015). *Reviewing the Post-2015 Sustainable Development Goals and Partnerships. A Proposal for a Multi-level Review at the High-level Political Forum.* SWP Research Paper 2015/RP1. Stiftung Wissenschaft und Politik, German Institute for International and Security Affairs, Vol. 4, Issue 3, 37-43.

Charter, M., Peattie, K., Ottman, J., and Polonsky, MJ. (2006). *Marketing and sustainability. Berlin.*

Geoff, L.,and Lesster, M. (2011). *Essentials of Marketing Management.* Routledge, Vol. 3, Issue 5, 76-82.

Glasbergen, P. (2010). Understanding partnerships for sustainable development analytically: the ladder of partnership activity as a methodological tool. The Netherlands.

James, P. (2015). Urban Sustainability in Theory and Practice Circles of Sustainability. (2016, April 5) Retreived from www.academia.edu

Keller, L.,K. (2013). *Strategic Brand Management.* Pearson Education Limited*:* Tuck School of Business .

Keller, L.,K. (2013) *The New Branding Imperatives – Insights for New Marketing Realities.* Marketing Science Institute, Vol. 8, Issue 4, 56-72.

Keller, L.,K., and Hoeffler, S. (2001). Building brand equity through corporate societal marketing, Journal of Public Policy & Marketing. Vol. 12, Issue 3, 32-41.

Keller, L.,K., and Kotller, P. (2012). *Marketing Management.* Pearson Education Limited.

Marrewijk, V., M., and Werre, M. (2003). *Multiple levels of corporate sustainability,Insustrial Marketing Management. Vol. 10, Issue 3, 67-73.*

Vinor, K., Zillur, M., Kazmi, A.,A., and Praaven, G. (2012). *Evolution of sustainablility as marketing strategy: Begining of new era*, International Conference on Emerging Economies - Prospects and Challenges. Vol. 10, Issue 11, 34-37.

Young, W., and Utting, K. (2005). Business and Sustainable Development. Journal of Business Ethics Vol.13, Issue 3., 44-46.

www.lubricants.total.com/pro/partnerships/automotive-partnerships (2016, April 10)

www.peugeot.com (2016, April 11)

www.unilever.com (2016, May 15)

SPONSORSHIP OF SPORTS EVENTS AS A MARKETING TOOL

Mila Petrović*[1], Jelena Vučinić[1]
[1]Faculty of Organizational Sciences
* Corresponding author, e-mail: mila.m.petrovic@gmail.com

Abstract: *The focus of this paper is the concept of sponsorship of sports events as a marketing tool of the sponsoring company. The areas which will be explored through the research are commercialization and development factors of the sports industry, as well as the concept of sports sponsorship and its main goals. The aim of this paper is to contribute to the scientific perspective of the sport event sponsorship, as well as to the quality of future sponsorships between the organizers and the companies.*

Keywords*: sponsorship, sport, event, sports events, marketing, marketing tool, communications*

1. INTRODUCTION

The development of modern technologies, digitalization and rapid exchange of information are just some of the trends that cause many changes in the way businesses and access to target groups with regard to the corporate sector. In recent years the increasing convergence of the sports and entertainment industry is noted, and thanks to new technologies, the sports events are getting more and more publicity. This further promotes not only certain sporting disciplines, but also organizations and companies that have supported and provided sports events to happen. The goal of this paper is to present the concept of sponsorship of sports events as a marketing tool by analyzing existing literature and modern marketing trends. In the beginning, the role of the marketing in the spots industry is explained, followed by analysis of the concept of sport events sponsorship.

2. ROLE OF THE MARKETING IN THE SPORT INDUSTRY

2.1. The commercialization of sports industry

The commercialization component is present in the sport for many years – even before the modern era, Greek athletes were receiving cash prizes for achieved sport results. However, not a single historical period is more characterized by rapid growth of commercialization in sport, as it is the case with the previous three decades. Today sport is a serious business where large companies take a great part and have influence on the development of the sports industry. Prominent athletes have become a product of this industry, sports teams and individuals are exchanged on the market, sponsorship of sports events cost millions of Euros and TV companies pay large sums of money in order to receive the right to broadcast these events. Furthermore, multinational component of sports industry makes it more challenging and appealing to the corporate sector. The importance of the marketing function in sport organizations is proved by the fact that more and more sports organizations employ marketing experts in order to design and organize specific campaigns. Commercialization of sport allows sports organizations to gain financial benefit for training and entertainment activities and this has become crucial for both development and survival of the sports industry.

2.2. Sports industry products

A product can be described as "*something that meets a need or desire while using*". Gerber-Nel (2004) says that product is a solution to the problem as its purchase provides some kind of a benefit. With that said, consumers actually buy the benefit, not the product. Sports products can be extremely complex, which is obvious when you take into account the different types of sports disciplines and events. Sports products are diverse and complex due to additional, mental and physical dimensions – some sports products affect consumer's mind (like in the case of a sports event), while others affect the body (like participating at the event itself). A sports game can be classified as a pure product, while the activities related to the game (food and beverages, merchandise, entertainment during half-time, video walls), can be classified as additional component to the product. Lately there are more experts who advocate that primary product (like football

match) is not the most important, and that marketing professionals need to focus on the positive experience of the consumer, rather than the outcome of a match.

2.3. Development factors of sports industry

According to a report published by the consulting company PricewaterhouseCoopers (2011), some factors that greatly influence the development of sports industry are:

- Sport and entertainment converge;
- Social media;
- Commercial challenges;
- Compensation for sports persons;
- Internationalization;
- Broadcast rights.

Every day we see an increasing **convergence of sports and entertainment industries** and their development that go along the development of modern technologies. Sponsorship and media rights have become the main sources of profit, putting into question the traditional ways of earning from sporting events. Event organizers are under pressure because poor organization of the event as a consequence has the abandonment of nowadays extremely important stakeholders – the media and the corporate sector. Sport and entertainment events are increasingly being staged together, as a way to enhance the overall experience and extend the length of events − and therefore the time that supporters and viewers stay. With an average US audience of 111 million viewers, the 2011 Super Bowl became the most-watched program of any kind in the history of American television. In addition to the sports game this event includes performances of the world's biggest music stars (PricewaterhouseCoopers, 2011).

The increased usage of **social media** is one more factor that has the great impact on the industry of sport. Social networking continues to create opportunities and challenges for traditional broadcasters, as well as to the faithful followers who are more interested to accept new ways of communication. Partly as a result of this open personal interaction, social media allows fans to get closer to athletes and sports personalities, and provides sponsors with an opportunity for two way communication, thus enabling them both to embed their brand, and also to understand and manage how fans perceive the brand. According to research conducted by Burst Media (2012), 45% of viewers aged between 18 and 35 years follow their favorite teams and athletes on social networks, and 35% of them regularly use social networks to find out or share sports facilities. Perhaps the most important effect of these networks, however, has been greater audience empowerment: individuals use technologies to become actual participants in the sport communication process. According to Newman (2013) it is important to note that social media have an impact on the visitor in various phases. Sports event marketing can begin before the visitor decide to attend, may be continued during the event and after the event ends. Sporting events are promoted ahead of time to build enthusiasm for the event. Promotion during and after the event are designed to encourage repeat consumption of rather sport, or the products of the sponsor"s company. Every aspect should be considered and planned for by sport professional. Furthermore, the use of social media at each point should be considered to maximize the number of “personal touches” the sport consumer experiences in relation to the event.

Sports industry today faces challenges when it comes to financial and **commercial aspects**. Organizers are under pressure to maintain and increase the value of the event in accordance to the ticket price increase. If viewers are paying more money, they expect an extra value in return. The same principle applies in case of gaining right to broadcast certain event. The balance between price and value is further complicated by the deep sense of ownership that many sports fans feel for their club or sport. Again reflecting trends in entertainment such as brand and product placement, sports sponsors want to be embedded within the product, rather than just being a name on a shirt. Naming rights remain a popular investment for sponsors, both for new and established sport and entertainment venues. Examples include Barcelona Football Club"s five and-a-half year, €171 million shirt sponsorship deal with the not for profit Qatar Foundation. (Barcelona considers ending Qatar sponsorship deal over 'social issues', 2015). However, this type of open commercialism does not always go down well with paying customers, and thousands of Barcelona fans signed a petition demanding the agreement be dropped.

In many professional sports, the focus on providing the most entertaining and successful product is driving rapid inflation in **player costs**. This leads to two types of risks when it comes to the sustainability of sport organizations. First of all, large payments are putting at risk the long-term survival of an organization whose core business is not fun, but professional sport. On the other hand, branch associations and organizations strive to keep good athletes with significant results, thus restricting their ability to monetize their work and glory. This problem can lead to shift of activities: for example, the start of the 2011–12 National Basketball

Association (NBA) season was delayed by a lockout caused by a standoff between players and NBA owners over revenue sharing and the structure of the salary cap (PricewaterhouseCoopers, 2011).

A further challenge for governing bodies is the increasing pressure to grow their sports in new **international markets**, while at the same time maintaining the local support base and the integrity of their competitions. The English Premier League has been widely criticized by fans and media worldwide for proposing a „39th game" in an overseas location (Chelsea fans oppose FAs Premier League proposal of staging a round of matches overseas, 2014). Yet some fans in other sports and countries are more welcoming of international expansion. Most notably, decisions have been taken to hold the FIFA World Cup in two emerging sports markets − Russia in 2018 and Qatar in 2022 (FIFA World Cup, n.d).

While **media rights** revenues are continuing on a generally upward path, the size of the market remains volatile year on year, depending on the presence or absence of major events such as World Cups and Olympics. What is more, the value of broadcast rights for international tournaments varies depending on local screening times in regions around the world. On purchase influences time zone of the event, and even the day of the week (PricewaterhouseCoopers, 2011).

2.4. Marketing of sports events

Goldblatt (2010) points out that in planning, preparation and maintenance of special events, marketing function is certainly of great importance for defining goals, build partnerships and promotional activities for the event itself. For example, in the preparation phase of the external events marketing has the task to provide sufficient financial and material sponsorship, or the number of tickets, to allow the prompt maintenance. Promotional activities of a special event can include: advertising, public relations, establishment of partnerships, physical promotion, guerilla marketing and direct, personal contact. If it comes to development of an internal, closed event for which there is defined and sufficient budget, the function of marketing is unloaded in terms of proving the financial justification or approval for certain actions. In this case, marketing is responsible for ensuring the appropriate number of guests/visitors. In both cases, the function of marketing carries the greatest responsibility when it comes to creating promotional materials and communication with stakeholders. The essence of the existence of the marketing campaign for the event is to ensure that every decision made in the planning and preparation of events brings added value to the overall outcome of the event. For this reason it is extremely important to choose a good strategy for the proper maintenance objectives, test all the ideas and use feedback to improve and develop creative solutions that will highlight the value of the event that visitors expect in exchange for a ticket or time invested.

3. SPONSORSHIP OF SPORT EVENTS

3.1. The concept a sport sponsorship

First ever sponsorships were noticed in a form of patronage, when patrons supported talented individuals who were building a career in culture or arts. Even in the early stage, the patrons expected something in return. During the Roman Empire, patronages were rulers and distinguished military representatives, and this role was later passed to authority representatives and aristocrats. Queen Elizabeth and King James I supported the work of Shakespeare (Shakespeare's Patron - Queen Elizabeth, n.d), while Roman Popes and other church figures supported Michelangelo and Leonardo Da Vinchi. In seventeenth century, the concept of sponsorship hadn't existed, but certain benefits for patronages, such as advertising, were introduced. This was one big step in building the modern concept of sponsorship.

Further development of the concept was noticed in twentieth century. In 1924, The Eveready Hour became the first ever commercially sponsored radio show (Biographical Dictionary of Radio, 2011). Golf, motor racing events and tennis matches were roots of the modern sponsored events. Companies from automotive, tobacco and alcohol industry were the first ones that were sponsoring events. In 1958, The Kentucky Derby Festival became the first ever event that had one of its activities named after a sponsor: Philip Morris Festival of Stars. The most important growth of this concept happened between 1970 and 1990. Even though many organizers were skeptical about losing their audience, they started to accept corporate sponsors more and more often. In that time, sponsorships still couldn't show any financial benefit – only advertising and publicity. The 1984 Olympic Games in L.A. were saved by corporate sponsorships and this was an important milestone in the development of the sponsorship concept. During the next 10 years, more than 40.000 events were organized only thanks to corporate sponsorships, which also caused companies to study the importance and effects of event sponsorships.

3.2. Global sponsorship market

Corporate sponsorships in Europe have drastically increased during the last years. In 1980s, when the concept was established in the USA, many European event organizers wanted to avoid having corporate sponsors, but after realizing that they are missing financial support, they skeptically started to cooperate with large companies. Thanks to a careful choice of the corporate partners, many events have established strong cooperation with the corporate world that gives them much more possibilities than they had before (Skinner, B. E, Rukavina, V, 2003). During the 1990s, the change in the way that cultural events were enabling the financial support was one of the biggest trends of the modern world, and many researches show that this trend is going to grow in the future. Corporate sector is seeing more and more different ways of participating in various events, not only cultural, but any events that have a positive contribution on the society. In 2014, the global sponsorship spending resulted a total of 55,3 billion USD, and it grew to a 57,5 billion in 2015. The forecast for 2016 is 60,2 billion, which means the market is growing year by year (Sponsorship spending worldwide by region 2009-2016 | Statistic, n.d). One of the reasons for this growth is an increase of the athletes and coaches paycheck. In the end of 2014, the number of companies that are investing over 15 million USD in sponsorships grew to 107. Among them, the leader is PepsiCo, whose yearly spending is between 355 and 360 million USD. The second and the third place go to Anheuser-Busch InBev and The Coca-Cola Company with yearly spending of approximately 300 million USD.

Sponsorship as a concept became an important item in strategic corporate planning and it is very likely that soon it will be an inevitable tool in companies" integrated marketing communications plans. This tool will allow companies to use the possibilities of traditional advertising, as well as emotional and experience benefits built through sponsoring a sports, cultural, art, educational or social event. What used to be a sponsorship with a minimal budget tends to grow into an important part of integrated communication channels, where sponsorship itself is just one element, and many other players have important roles in its success.

3.3. Goals of sport sponsorship

The International Events Group defines sponsorship as "*financial contribution to sports, art, entertainment or other industry entities that allows sponsors to use the commercial potential of these entities*". (Skinner, B. E., Rukavina, V, 2003). According to various researches, companies sponsor events mainly for their own interest. However, reasons that can influence corporate and employer brand, such as raising awareness about a certain social problem or community contribution, are also present. The definition of sports sponsorship in the words of Shank (2009) is "*Investing in a sports entity (athlete, league, team or event) to support overall organizational objectives, marketing goals and/or promotional strategies*." Amis, Slack and Berrett (1999) believe that "*sport sponsorship should be considered an important resource which can help companies to secure a position of competitive advantage*". They presented the results of an analysis of 28 national and multi-national Canadian firms that had been involved in sport sponsorships at the national or international levels and they "*tried to demonstrate that sponsorship can be an extremely valuable resource with great utility in a firm's quest for a sustainable competitive advantage. For this to be achieved, however, the firm must approach any sponsorship agreement as a potentially valuable resource worth spending time and effort on developing.*"

One of the biggest benefits of sports sponsorships is raising the brand awareness. Miloch and Lambrecht (2006) conducted a research regarding consumer awareness of sponsorship at grassroots sport events. Generally, the recall and recognition rates in this study were slightly lower but comparable to sponsorship awareness studies, particularly those focusing on large sports events. This suggests that when compared to mega-event sport consumers, participants and spectators at grassroots and niche sport events may not possess the same level of sponsorship awareness. However, according to authors "*sponsorship of grassroots and niche sports has proven effective in generating a return on investment for sponsors at this level*". Another study (Biscaia, Correia, Rosado, Ross, Maroco, 2013) examined the relationships between both attitudinal and behavioral loyalty with sponsorship awareness, attitude toward two actual sponsors, and purchase intentions. Results indicated that *"although fans may be aware of a great amount of team sponsors, their intentions to purchase sponsors' products will only increase if they develop a favorable attitude toward those sponsors"*. Therefore, this study *"highlights the role of focusing on actual sponsors, rather than generic sponsors, given that the relationships between the team loyalty constructs and sponsors' outcomes differed according to each of the sponsors".* The main reason for including sponsorships into a marketing mix of the company is the overall presence of sports in everyday lives of people of different age and lifestyles. Polonsky and Speed (2001) reckon that management of the sponsor company firstly should answer the following questions: What type of consumer is targeted (existing or new)? What type of customer

action is required (purchase or purchase and secondary action)? What is the firm's financial commitment (unlimited or capped)? What leveraging activities are required?

Just like advertising, the goals of sports sponsorship can be direct and indirect. Direct goals are connected to short-term buyers" behavior and sales incensement. When it comes to indirect goals, it can be intent to build a corporate image, or a specific brand promise. All goals can be grouped in a following way:

- **Raising the awareness about the company.** When sponsoring a sports event, a company is being exposed to a large audience. This means the company is raising the awareness about its product, service, or corporate image. Various researches prove that sponsoring an event gives much better results when it comes to raising the awareness about the brand, than traditional advertising does. According to one respondent in the study that was conducted by Farrelly and Queste (2005) "*sponsorship value will always be evaluated in terms of contribution to the brand, and weighed up against what was spelled out in the original agreement such as the level of sales and gains in brand preference in select markets.*"
- **Market positioning.** Another goal can be to eliminate any kind of competitor threat and increase the position on the market. In other words, if a company decides not to sponsor an event, it is very likely that its competitor might decide to do so.
- **Reaching the target groups.** If target group of the company matches the target group of the event, a company can benefit of the sponsorship much more than of traditional advertising activities. Sports industry is a great example for this. For example, if a company that produces sports goods sponsors a marathon, the company is automatically targeting its potential buyers.
- **Relationship marketing.** Building the relationship with the customers could be another motivation for companies to sponsor an event. If a company representative participates in the event, he can get in touch with current and potential clients, establish cooperation and help in building their business. VIP lounges are a typical practice when it comes to sports events that prove this goal. Tsiotsou and Alexandris (2009) believe that "*highly attached fans are more likely to develop positive image about their team's sponsor and consequently express positive intentions to say good things and buy the sponsor's products.* They propose marketers to *"work on the development of team attachment and the creation of positive sponsor image, in order to increase sponsorship effectiveness*".
- **Building the corporate image.** Many companies are investing a lot into creating a unique public presentation. For many companies that are doing B2B business, sponsorships are a way to communicate their internal values externally. Events that these companies sponsor should be chosen carefully, as the whole image depends on the success and publicity of the event, and the message it sends to public. For example, message that is being sent by the organizers of Formula 1 events – fast, dangerous, courageous, exciting and risky – can fit many organizations that want to present themselves as dynamic. However, it would not be an appropriate event for companies that want to position by communicating different values: calmness, safety, security, stability – for example, insurance companies. Every sponsored event should be aligned with company"s corporate values. One study has put things in perspective for many sport marketers in that "*logo placement, along with myriad of other sponsored activities at the venue, is just a small fraction of what the spectator visually records and assigns meaning to. In order to transcend the illusion of effectiveness and elevate sport sponsorship activation to another level, sport managers today must provide an experience that is more than a simple, one-dimensional logo viewing*" (Choi, 2006).
- **Sales increase.** This is a common goal for all companies that sponsor sport events - usually the ones selling sports goods or services. It happens often that events are being created especially for the sponsor in order to achieve sales goals and increase the profit. Without sponsors, some sports events today would not be possible, which give the right to companies to have a certain financial benefit.
- **Relationships with the local community.** When companies sponsor a sports event, they are sending a message that says they support sports and physical activity. Consumers connect these companies to a positive contribution on the society. In some countries where the government does not invest in sports a lot, corporate sector holds the key role when it comes to building a healthy society environment and contributing to sports activities.

3.4. Measuring the effects of sports sponsorship

When it comes to measuring the success of sponsorship investment, it is important to measure it from signing the contract until the end of follow-up activities. Meenaghan (1991) suggests the following methods of measurement:

- **Measuring media coverage.** Sponsors are often using media coverage as an indicator of success. Evaluation of this kind could be measured in the following ways: time of media stream, number of viewers or printing amount. It is very important to note that this method measures only the coverage

without its actual effect. Apart from traditional media channels, the big influence is now related to social media and web portals.

- **Measuring communication odds of sponsorship investment.** Sponsors tend to measure communication success of the event, since sponsorship is used to achieve communication results such as raising and increasing brand awareness, etc. Some sponsor companies are measuring the sponsorship success by conducting surveys to find out how many are people connecting the event with their company.
- **Measuring sales efficiency of the sponsorship.** Sponsorship is facing similar problems as traditional advertising or other communication activities, when it comes to relationship between sales results and sponsorship investment. This happens for many reasons and some of them are usage of different marketing tools at the same time, previous marketing activities and competition behavior. However, many sponsors are often using sales results to prove the success of sponsorship investment, even when it is very difficult to measure results.
- **Monitoring attendees' feedback.** In some cases, when relationship with the attendees is one of the goals of sponsorship, monitoring their feedback can be a good way to measure the effect. This feedback can also be useful when it comes to evaluating event organizers.
- **Cost-benefit analysis.** When a company has more philanthropic than commercial reasons to sponsor an event, that company should conduct other ways of measuring the effects, different than traditional ways. In this case, the most important activity in the process of measuring is to research and define the stand of top management which will be used as a base for measuring.

3.5. Good case practice – "Thank You, Mom" campaign by Procter and Gamble

P&G, the largest Consumer Packaged Goods company in the world was a mid-tier sponsor of the 2010 Winter Olympic Games. This impactful investment led to an "Official Olympic Sponsor" of the Summer Games in London. The idea of their „100-day phased plan" across creative, media, PR, and shopper marketing outlets, was to create a global "Thank You Mom" movement and celebrate mothers who inspired, sacrificed and supported each athlete in their quest for Olympic glory. Through moms of the Olympians, they connected to all mothers, P&G"s core consumers. The company used social media to debut the emotionally powerful "Best Job" video that introduced "Thank You, Mom" and "Proud Sponsor of Mom" messaging. Within three weeks, "Best Job" became a digital sensation, and that was just the beginning. The plan allowed P&G to control the level of connection to the Olympics, growing more prominent as the Games drew nearer.

This was the most successful campaign in P&G"s 175 year history that delivered $200MM+ incremental sales (USA) and record-setting P&G ROI results. It increased brand portfolio linkage to P&G for 11% and recall of P&G"s ads was +38% higher than other US Olympic sponsors. Other important results include 33.6 billion earned media impressions, 17 million views on YouTube, 65% increase in number of Facebook fans and 20 time more in Twitter followers (Medaling In Media: P&G Proud Sponsor of Mom, n.d).

4. CONCLUSION

Year by year, sports industry marks a significant growth and the some investments top GDPs of many countries. Sports industry is coming closer to entertainment, which means possibilities for commercial activities are growing. A modern consumer does not want only a product that will fulfill his basic needs. He wants a product that he will be able to identify with, a brand whose values he could live every day. Sports industry is getting in touch with a large audience, with people of different age, location or lifestyle, which means it is a perfect ecosystem for reaching a wide audience, as well as specific targeted groups. However, it is important to note that sponsorship of sports events now days go far beyond a one-dimensional logo viewing. Generic sponsors do not add specific value to an event – and along with that, they cannot expect a lot in return either. When making a decision about sponsoring an event, sponsors should focus on their customer and its needs. Together with the organizer, they should aim to provide an extraordinary experience to their customer – through brand activation and other, specific company-related activities, which will allow them to fully utilize and maximize the investment of the sponsorship. As technology is in a fast progress, there can be more ways to both track, measure and evaluate sponsorship investment, as well as to engage the spectators and a specific target group more deeply during the sponsored event.

REFERENCES

Amis, J., Slack, T., & Berrett, T. (1999). Sport sponsorship as distinctive competence. European journal of marketing, 33(3/4), 250-272.

Barcelona consider ending Qatar sponsorship deal over 'social issues' (2015). Retrieved April 24, 2016, from http://www.theguardian.com/football/2015/jan/27/barcelona-qatar-sponsorship-social-issues

Biographical Dictionary of Radio. (2011). Retrieved April 25, 2016, from https://books.google.rs/books?id=XDB5mn0OMXoC

Biscaia, R., Correia, A., Rosado, A. F., Ross, S., & Maroco, J. (2013). Sport sponsorship: The relationship between team loyalty, sponsorship awareness, attitude toward the sponsor, and purchase intentions. Journal of Sport Management, 27, 288-302.

BurstMedia. (2012). Retrieved from: http://www.dr4ward.com/dr4ward/2012/11/how-many-sports-fans-go-digital-infographic.html

Chelsea fans oppose FAs Premier League proposal of staging a round of matches overseas. (2014). Retrieved April 24, 2016, from http://www.telegraph.co.uk/sport/football/teams/chelsea/11154033/Chelsea-fans-oppose-FAs-Premier-League-proposal-of-staging-a-round-of-matches-overseas.html

Choi, J. S. A. (2006). Visual ethnography of on-site sport sponsorship activation: LG action sports championship.

Farrelly, F., & Quester, P. (2005). Investigating large-scale sponsorship relationships as co-marketing alliances. Business Horizons, 48(1), 55-62.

FIFA World Cup. (n.d.). Retrieved April 24, 2016, from https://en.wikipedia.org/wiki/FIFA_World_Cup

Gerber-Nel, C. (2004). Determination of the brand equity of the provincial, regional and national rugby teams of South Africa (Doctoral dissertation, UNIVERSITY OF SOUTH AFRICA).

IEG's Top Spenders List. (n.d.). Retrieved April 25, 2016, from http://www.sponsorship.com/iegsr/2015/08/03/The-Deepest-Sponsorship-Pockets-of-2014--IEG-s-Top.aspx

Media: P&G Proud Sponsor of Mom. (n.d.). Retrieved April 25, 2016, from http://www.aef.com/pdf/jay_chiat/2013/p&g_olympic_proudsponsor.pdf

Meenaghan J.A. (1991), Sponsorship - Legitimizing the medium, European Journal of Marketing

Miloch, K. S., & Lambrecht, K. W. (2006). Consumer awareness of sponsorship at grassroots sport events. Sport Marketing Quarterly, 15(3), 147.

Newman, T. (2013). Social media in sport marketing. Scottsdale, AZ: Holcomb Hathaway. Retrieved April 24, 2016 from: http://www.hh-pub.com/client/samples/hh2785.pdf

Polonsky, M. J., & Speed, R. (2001). Linking sponsorship and cause related marketing: Complementarities and conflicts. European Journal of Marketing, 35(11/12), 1361-1389.

PricewaterhouseCoopers. (2011). Changing the game. Retrieved April 24, 2016 from: http://www.pwc.com/gx/en/industries/hospitality-leisure/changing-the-game-outlook-for-the-global-sports-market-to-2015.html

Shakespeare's Patron - Queen Elizabeth. (n.d.). Retrieved April 25, 2016, from http://www.shakespeare-online.com/biography/patronelizabeth.html

Shank, M. D. (2009). Sports marketing: A strategic perspective. Upper Saddle River, NJ: Pearson Prentice Hall.

Skinner, B. E., & Rukavina, V. (2003). Event sponsorship. Hoboken, NJ: John Wiley & Sons.

Sponsorship spending worldwide by region 2009-2016 | Statistic. (n.d.). Retrieved April 25, 2016, from http://www.statista.com/statistics/196898/global-sponsorship-spending-by-region-since-2009/

Tsiotsou, R., & Alexandris, K. (2009). Delineating the outcomes of sponsorship: sponsor image, word of mouth, and purchase intentions. International Journal of Retail & Distribution Management, 37(4), 358-369.

INNOVATIVE APPROACH TO ONLINE MARKETING FOR BOOK PUBLISHERS

Milan Prtenjak
Klett Publishing House Ltd. – Belgrade
*Corresponding author, e-mail: milan@klett.rs

Abstract: *Books and publishing business have undergone tremendous changes since 1980s. The causes of these changes are numerous, however the main cause can be stated as being digitization, which has brought novelties in all business processes of publishing houses.*

Publishing houses are faced with great challenges and books, as both commodity and cultural asset, don't have the same status in the society as once did. Book publishers need to find ways to remain profitable in new circumstances. If online marketing is implemented appropriately in the business of publishing houses, it can be more efficient and much more cost effective than traditional marketing.

The paper shows a digital marketing model that can be applied for the realisation of business and marketing objectives of publishing houses. The model will be reviewed through a product policy, electronic customer relationship management (eCRM) and communication policy.

Keywords*: book publishing, online marketing, eCRM, website, social media*

1. INTRODUCTION

Book publishing is a centuries-old business and cultural activity. Since release of the programming language PostScript (1984) and the program for desktop publishing PageMaker (1985) book publishers have been dealing with numerous changes in all aspects of their business. It can be contended that today's numerous and intensive changes were primarily caused by technology (Tat Keh, 1998). The application of digital technologies has caused that only traditional, printed books remain analog (MacRitchie, 2009). Although it is impossible to predict the further development of book publishing, it may be presupposed that many changes are still to come (Hughes, 2014) and book publishing will hereafter be very active and unpredictable activity.

Book publishers face considerable challenges and as a threat to their success may be listed the following issues (Hughes, 2014):

- Publishers and authors consider all books as potential bestsellers.
- According to the information from the people in the publishing business, 60–80% of all titles do not bring money or they are unprofitable in the first year.
- Traditional models of success prediction cause high risk of unprofitability.

Regardless of their size and history, publishing houses cannot focus only on their primary activity ignoring the changes that affect the market, readers and society as a whole. Every publishing house which wants a long-term success should be aware of global and market-specific changes and needs to respond quickly to all new factors. One of the ways to respond to modern requirements is the application of appropriate business strategies which would include online marketing.

2. MARKETING STRATEGY FOR BOOK PUBLISHERS

Today's media are being consumed in digital form, while users expect to access online content very easily. This applies to all traditional media – newspapers, television, radio, music, film. Due to the large amount of online content that is being offered without a charge, users expect to pay only for exclusive content. Media companies and content creators decide whether to create free content for the mass market or exclusive content that will be charged. Many news websites and cable television networks charge for the access to their content because of the quality they offer. Book publishers do not have a possibility to choose whether they will create free or exclusive content. Despite the form of the final product (printed book, ebook, audio book) book publishers need to create the content of premium quality which will be charged.

Book publishing has traditionally been product-oriented and marketing activities have been primarly focused on the promotion of new titles (Clark, 2014; Vulf, 2011). The user is becoming even more important in the competitive enviroment but also more demanding and less loyal. Book publishers need to break a long tradition and focus on their customers. Although some authors have enormous success which can affect the

profitability of their publishers for a long time, all publishing houses actually serve niche markets (Clark, 2014). It is very important for every publishing house to define the target group, its size and potential value. Book publishers should build long-term and direct relationships with their customers in accordance with their business and marketing strategy. As a result, the production of new books needs to be aligned with the customers' needs.

This paper describes how book publishers can use online marketing as an integral part of their business strategy, enabling them long-term profitability. The proposed method includes three components which should be applied together:

1. Product policy
2. eCRM
3. Communication policy

2.1. Product policy

The book as a product is the basis of every publishing house (Then & Schmidt-Stölting, 2009). In order to be profitable, it is essential for a publishing house to publish every year a sufficient number of new titles which will be successful in the market. The commercial success of a book can be affected by many factors, but the most common reason for book purchasing is its topic (Vulf, 2011). However, a high percentage of fruitless titles is typical for book publishin.

Every published book starts from the manuscript which a publishing house acquires from its author. The acquisition of the manuscripts has traditionally been left to the editors who don't know neither the market nor the readers. The marketing strategy of publishing houses should include the acquisition of the manuscripts in agreement with the marketing department.

The acquisition of new manuscripts can occurre in two ways: (1) The book publisher can invite the authors over the website to apply following the given instructions, and (2) The book publisher can actively seek the authors in accordance with the publishing plan. The Internet can be very helpful for finding new authors, especially blogs and social media. Successful bloggers prove that they know how to write about a particular topic in a way that attracts the audience and the visitors of their blogs represent at the same time the future readers of the book. Social media allow individuals to become popular avoiding traditional media and book publishers can assess their potential for writing a book.

The customers from the target group can be involved in the book production after the acquisition of a manuscript. The reasons for this are: (1) Customer feedback during the editing and designing process and (2) Establishment of the direct contact with the target group. In the case of less demanding activies such as choice of cover, title, etc. the publishing house can use social media and emails to invite the customers to participate. If users are expected to do more demanding tasks such as reading and commenting the manuscript, the publishing house can invite a certain number of users to a long-term cooperation with financial compensation. Such users could be the promoters of the published books, especially it they have their own blog or are active users of social media.

Through the process of book publishing, publishing houses add value to the manuscript in order to sell it at a higher price than the total costs of its production (Clark, 2014). The Internet allows publishers to add value to the already published books. While the website of the publishers of fiction can contain videos, audio recordings, press releases, etc. textbook or non-fictional publishers can provide additional materials such as files for exercises, online tests, learning management systems, webinars, etc.

2.2. eCRM

Successful online marketing strategy in today's competitive environment should include the implementation of CRM (customer relationship management). CRM is a strategy in an organization that is widely implemented to manage and promote the company's interactions with customers (Arab, Selamat & M. Zamani, 2010). It involves managing detailed information about individual users. The application of technologies that support CRM is the key element of online business (Chaffey, 2015) and the task of eCRM (electronic customer relationship management) is to establish and maintain long-term relationships with clients. Today CRM cannot be separated from eCRM (Chaffey, 2015).

While traditional marketing represents the mass marketing, the Internet has enabled a user-oriented marketing that helps establishing long-term relationships with customers. Monitoring of former and current user behavior enables better planning and implementation of future marketing activities.

Book publishers are still inert when it comes to user data and their use. The reason for this may be the lack of experience because the contact with customers is usually being established indirectly over bookstores. There are no available data about the use of eCRM among book publishers, but all those who want to build direct relationships with their customers should use them in the future.

eCRM includes creating user profiles, tracking their purchase history and buying habits which allows better understanding of users' needs and builds the fundament for communication with them. It is essential that publishing houses collect data from every touchpoint with their customers – website visits, shopping, contacts with sales representatives, phone calls and emails received from customers, communication via social media, etc. After establishing of direct contact with the customers, book publishers enhance understanding of users' needs and can create books which will have a superior value for them. The decision on new titles should also be based on the information about the customers which could increase chances for market success and at the same time can win a loyal customer.

2.3. Communication policy

The Internet and especially Web 2.0 represents the Copernican revolution in communication between users and organizations. Users are no longer passive recipients of messages, but they are able to initiate communication with publishing houses or other users, primarily using social media. While the communication in traditional marketing can be personal (book promotions, book fairs, etc.), such contacts are short and superficial. Online communication allows establishing and maintaining direct and long-term contacts with customers.

Every book publisher can choose tools for online communication in accordance with its resources and marketing objectives. The available online tools can be the following:

- Website
- Blog
- Search engine marketing (SEM)
- Email marketing
- Social media marketing
- Online PR.

In order to use online tools for communication with their customers, book publishers should conduct analysis, planning, implementation and control.

A **website** is the key marketing tool for publishing houses (Baverstock, 2015). It is the core of the entire online communication for an organisation (Olbrich, Schultz & Holsing, 2015). The building of a website is a long-term process that never ends. The website of a publishing house is the hub which connects offline and online communication since the instruments of traditional marketing (catalogues, brochures, etc.) need to guide users to the website. A website can have an informative role but also can offer an online shop with payment system. Regardless of the funcionality of the website, particular attention should be payed to its information architecture, usability principles and user-centered design. However, the website design should be in accordance with the profile of the publishing house and its target group. A website of the academic publisher is expected to be significantly different then the one of a publishing house for children's books.

Every published book should have its own web page which can be reached with links from other web pages or easily found using the search. Such web pages can contain detailed the data about the book with clearly highlighted title, author's name, year when it was published, format, synopsis, sample pages and the list of other books written by the same author.

The books on the website should be grouped into specific categories in order to help visitors to find them. The same categorisation can be used for creating of user groups in the eCRM system. The publishers of fiction can classify their titles by genre (thrillers, romance novels, historical novels, classic literature, etc.), while textbooks can be classified by school subjects.

A website of publishing houses can be used for creating additional value to the books with additional materials for the visitors (video materials, online exercises, software, files for download, etc.). Some books can have their own websites if the publisher expects them to be very successful. In the case of book series such websites can be popular for a long time.

If we assume that book consumers like to read, a **blog** could be an effective communication tool. Blog posts can be written by employees or the authors who operate with the publishing house. The topics and format of the blog posts depends on the profile of the publishing house and their target group. In some cases a blog can be launched only for one book as a promotion tool.

Search engine marketing (SEM) is a set of measures which aim is a better position of a specific web page in the search results of the web search engines. As their goal is expected more visits of the web page. SEM consists of SEO (search engine optimisation) and search engine advertising. The factors which affect the position of the web page in the search results can be external and internal. One of the most important external factors is popularity of the links, ie. number and quality of inbound hyperlinks. The internal factors can comprise the structure and the content of the web pages. The obtained results are called organic search results. Search engine advertisement turn on advertisements on the web pages with the search results. Everyone who is responsible for SEM in the publishing house should focus on the keywords which are expected to be used by consumers. Book publishers may use experts for SEM, but much can be done with good structure of the website and web pages.

Email marketing involves systematically sending of emails with the information which correspond to marketing objectives (Olbrich, Schultz & Holsing, 2015). Although it was believed that social media would decrease the popularity of email marketing, it is still important for business purposes. Email can be used for the communication with customers and their retention. Email is also an efficient way of direct marketing and can be useful as a sales channel.

The main prerequisite for an effective email marketing is a list of recipients. Email addresses can be collected through the website, but book publishers should every opportunity to collect them asking the visitors to give their email addresses if they want to be kept informed.

Newsletter is a special kind of emails that are sent to a specific schedule (usually once a week or once a month). If the publihshing house have different publishing programs for different consumers, the recepients of newsletters can be classified by genres. Email marketing offers insight into the success of the campaigns and book publishers can analyze the percentage of delivered emails (delivery rate), percentage of open mails (open rate) and the percentage of clicks on the link (clickthrough rate).

Since **social media** are popular all age groups, their application is indispensable in online marketing. Although there are many papers dealing with the theory of social media, there is still no universal definition of the term. For the first time in history all social strata have powerful instruments to affect the public opinion and inititate communication with organizations. Social media enable their users to be content crators.

All social media share the same characteristics (Olbrich, Schultz & Holsing, 2015):

- topicality
- virality
- multimedia
- spatial and temporal availability
- interactivity
- price/quality ratio.

Facebook is the biggest opportunity for book publishers because it is the most widely used marketing tool (Baverstock, 2015). Its advantage is the large number of users and a book publisher can find his targer group among them. In comparison with the Facebook profile, book publishers should create the Facebook page. This means that users don't need to send friend requests and there is no limit of 5,000 friends. In addition, the Facebook page provides analytics that tracks the performance of the posts. Posts can represent different kind of materials which are supposed to be interesting for users (text, images, links, videos). The publishing house should have the strategy of post publishing and needs to resond quickly to user comments.

According to official data, there are 380,000 Twitter users in Serbia. From this reason, Twitter can also be used as a part of the online marketing strategy. The Twitter timeline also enables posts of different content and it is particularly suitable for sharing links that lead to other relevant content. It is recommended for publishers to post news, opinions, interesting stories, links to interesting content, daily tips, links to the website or blog and links to the competition (Baverstock, 2015).

The popularity of YouTube and low cost of video production can be used for video content. A publishing house can have its YouTube channel with relevant videos about books and their authors.

The focus of the PR activities should be positive relations between organization and its environment. PR in publishing business involve creating free publicity and enhancing the brand using authors and media (Clark,

2014). Traditional PR instruments in book publishing are press conferences, book presentations, book fairs, interviews with book publishers or authors, telephone interviews with media representatives, PR ads, etc.

Online PR have the same function as traditional PR, but their key element is maximizing of positive references to organizations, brands, products or websites of third parties which are online and can be follow by the target group (Chaffey, 2015). Since some individuals can be influental online, it is important to build long-term relations with them. It can be bloggers, tweeters, Instagram users with a large number of followers, admins of online forums, etc. As tools for online PR activities can be used corporate website, social media and blogs which can transmit important information. Since the social media enable a two-way communication, they can be used for asking questions, commenting or expressing of complaints. Fast responding is very important in such situations, but the book publisher needs to analyse the reasons for customer complaints in order to improve the quality of products or services. Mistakes in books, especially in textbooks, can cause attention of the social media users and journalists as well, which could bring negative publicity to book publishers.

3. CONCLUSION

Tremendeous changes in book publishing primarily caused by new technlogies require from publishers to change their centuries-old way of doing business. Regardless of the tradition and a cultural role that book publishing has, it is essental for book publishers to create bussines and marketing strategies which will include online marketing. The focus of the strategy should be the customer and his needs. Choosing the target group and serving it with online marketing can be the basis for profitability of a publishing house. The model proposed in this paper can be applied to publishing houses in Serbia and abroad.

REFERENCES

Arab, F., Selamat, H., Zamani, M. (2010). An overview of success factors for CRM. *Information and Financial Engineering (ICIFE), 2010 2nd IEEE International Conference on, Chongqing*, pp. 702-705. doi: 10.1109/ICIFE.2010.5609453

Baverstock, A. (2015). *How to Market Book*s (5th ed.). Routledge, New York

Chaffey, D. (2015). *Digital Business and E-Commerce Management* (6th ed.). Marketing Insights Limited, 2015

Clark, G., Phillips, A. (2014). *Inside Book Publishing* (5th ed.). Routledge, Oxon

Direkcija za elektronsku upravu, Ministarstvo državne uprave i lokalne samouprave, „Smernice za upotrebu društvenih mreža u organima državne uprave, autonomne pokrajine i jedinica lokalne samouprave“ Hughes, B. (2014). A Different Way to Get to a Better Bottom Line in Publishing. *Publishing Research Quarterly, Volume 30, Issue 3*, pp 295-299

MacRitchie, J. (2009). Never Mind the Web: Here Comes the Book. *The Electronic Library, Vol. 27 Iss: 5*, pp. 885–886

Olbrich, R., Schultz, C. D., & Holsing, C. (2015). *Electronic Commerce und Online-Marketing* (1st edition). Springer-Verlag, Berlin & Heidelberg

Tat Keh, H. (1998). Evolution of the book publishing industry: Structural changes and strategic implications. *Journal of Management History (Archive) 4:2*, 104-123

Then, M., Schmidt-Stölting, C. (2009). Marketing – Markt und Meute *in Ökonomie der Buchindustrie*, Gabler | GWV Fachverlage GmbH, Wiesbaden, p. 144–158

Vulf D. fon, L. (2011). *Ekonomika izdavačke delatnosti* (1st edition). Clio, Beograd

OPERATIONS MANAGEMENT 946

TRACKING OF KEY PERFORMANCE INDICATORS BY USING CONTROL CHARTS: CASE OF OEE STABILIZATION 947
Vasić Danko, Gregec Nikola, Rakićević Zoran

A NOVEL ALGORITHM FOR COMBINATORIAL PROBLEM IN MANUFACTURING CELL FORMATION 954
Danilović Miloš, Ilić Oliver

APPLICATION OF MODERN CONTROL THEORY TO INVENTORY CONTROL IN PHARMACEUTICAL DISTRIBUTION COMPANY 962
Đorđević Lena, Antić Slobodan

STATIC CODE ANALYSIS AND REPORTS BASED APPROACHES FOR SPREADSHEET ERRORS DETECTION 970
Živić Miloš, Đorđević Lena, Lečić-Cvetković Danica

AN OPTIMIZATION-SIMULATION APPROACH TO ADVERTISEMENT PLACEMENT PROBLEM 978
Marković Stefan, Vujošević Mirko

RATIONALIZATION OF STORAGE COSTS BY APPLICATION OF MODIFIED SMED METHOD 986
Milanovic Dragan, Nestorov Aleksandar, Misita Mirjana

KEY PERFORMANCE INDICATORS AND PRICING STRATEGIES PLANNING IN RETAIL INDUSTRY 995
Radonić Milenko, Đorđević Vedrana, Omerbegović-Bijelović Jasmina

OPEN SOURCE ENTERPRISE RESOURCE PLANNING: SOLUTION FOR PRODUCTION PLANNING IN SMEs 1003
Rakićević Zoran, Omerbegović-Bijelović Jasmina, Lečić-Cvetković Danica

GPI PROCESS PERFORMANCE MEASUREMENT MODEL 1011
Simeunović Barbara, Slović Dragoslav, Radović Milić

DETERMINATION OF FAILURE DISTRIBUTION PARAMETERS FOR BANBURY MACHINE 1020
Şirin Aydın M., Güney Baha, Teke Çağatay

OVERALL ORGANIZATIONAL PERFORMANCE: A NOTE ON FIRMS OPERATING IN THE WESTERN BALKANS REGION 1027
Stefanović Ivan, Marčetić Nenad

IMPROVING EFFICIENCY OF ENGINEER-TO-ORDER OPERATIONS THROUGH LEAN IMPLEMENTATION: EMPIRICAL RESEARCH 1036
Tomašević Ivan, Slović Dragoslav, Stojanović Dragana

TOWARDS SUSTAINABILITY: MASS CUSTOMIZED-LEAN-AGILE-FIT OPERATIONS MANAGEMENT IN BANKING 1045
Tornjanski Vesna, Marinković Sanja, Jančić Željka

APPLICATION OF THE GAMES IN TEACHING LOGISTICS AND SUPPLY CHAIN MANAGEMENT IN THE REPUBLIC OF SERBIA 1056
Cvetić Biljana, Milenković Nemanja

OPERATIONS MANAGEMENT

TRACKING OF KEY PERFORMANCE INDICATORS BY USING CONTROL CHARTS: CASE OF OEE STABILIZATION

Danko Vasić*[1], Nikola Gregec[1], Zoran Rakićević[1]
[1]University of Belgrade, Faculty of Organizational Sciences
*Corresponding author, e-mail: dankan93@gmail.com

Abstract: *The purpose of this paper is to introduce the importance of putting Key Performance Indicators (KPI) into the holistic view of Continuous improvement methodology in modern manufacturing enterprises. The research was based on the continuous tracking of the OEE (Overall Equipment Effectiveness) indicator using the common tool of Lean approach – control charts. The simulation has consisted of two different types of control charts. Adopted conclusion expresses that fluctuation of OEE, and functioning of the fictive company itself, are susceptible to a positive influence of Lean management models. This study could be valuable, both for the academic and practical purpose, due to its structure which contains the practical method for measuring and continuous improvement of the production process, as well as the obtained business result itself.*

Keywords*: KPI, continuous improvement, lean manufacturing, OEE, control charts, simulation*

1. INTRODUCTION

In the modern business environment, there is the essential need to be constantly aware of extremely fluctuated market trends. After the commonly followed Western approach in business philosophy, today's importance of cost reduction principle caused the huge percentage of successful enterprises that base their business processes on Japanese Lean manufacturing model. Furthermore, the lean approach doesn't only mean the lower costs and money saving, but also the focus on involving all process participants in the venture of developing every single part of it.

Sources of knowledge which were being used during the research were the academic database of scientific papers (Science Direct, JSTOR, etc.). These sources were combined with the several case studies that were the basis for executed simulation. Using this kind of method, it has been tried to present how the appropriately established process of tracking and "attacking" the deviations, could lead to their reduction and bringing the business parameters into the zone of conformity.

The rest of the paper is organized as follow: Section 2 introduces the concept of KPIs and their definition and purpose. Section 3 describes how previously mentioned indicators could be involved in arranged system of continuous improvement, where management could derive the real meaning conclusions from indicators´ quantitative structure. After the section 4, which is related to the concept of control charts, section 5 is written to explain OEE indicator, as well as the simulation process carried out by using both mentioned tools. Section 6 concludes the paper with the review of the presented study and future research intentions.

2. KPIs – DEFINITION AND PURPOSE

In spite of growing importance of controlling and monitoring different business activities and results, putting performance measurement in place has always been a daunting task. Reasons such as the lack of incentives and top management support, as well as an organizational culture unfavourable to performance measurement, often make the development of performance measurement tool complicated and very challenging for ordinary businesses (Lindberg et al., 2015).

Cyclic management systems provide the basic concept, on which performance measurement system is based. This system is carried out by monitoring performance indicators, whose values indicate the results of certain management actions. Performance measures are system parameters or the method for quantitatively defining the process to be considered following the procedures of measurement and evaluation of performance. The main advantage achieved by the application of this kind of business approach is the possibility to provide information on potential quality improvements of company's performance.

In today's world economy, KPIs are an important tool to manage companies. In the first place, KPIs are used to divide important from unimportant information, simplify complex subject matters and create transparency. KPIs represent a set of measures focusing on those aspects of organizational performances that are the most critical for the current and future success of the organization (Parmenter, 2007).

In almost all modern business, we can always identify existence of time gap between the planning and execution. Because of this reason, different, unexpected events often occur during the execution. Consequently, there is always a gap between what was planned and what is actually done. In accordance with this problem, all of modern, competitive companies and their members need to make continuous efforts (or adaptations) to close the gap.

Performance metrics or KPIs offer the overall visibility of all company's processes and help to assess the accuracy of all plans (e.g. forecast accuracy), and the execution performance (e.g. actual sales versus forecast plan). KPIs reveal the gap between plan and execution and offer opportunities to identify, analyse and correct potential problems. Therefore, carefully selected KPIs precisely show where to take action in order to improve performance. KPIs help an organization to define and measure progress towards selected goals. If an organization has defined its goals, then it is more important for them to measure the progress of those goals (Jevgeni & Eduard & Roman, 2015).

Based on extensive analysis and discussions with over 1,500 participants in KPI workshops, covering most organization types in the public and private sectors, some of the basic KPI characteristics were defined. As examples, it can be highlighted that they are nonfinancial measures, which are frequently measured, and also make a significant impact on all company's processes (Parmenter, 2007).

One of the crucial tasks that refer to KPIs is a challenge of choosing number of KPIs that will be defined and monitored for a particular company. Unlike a general perception that more is better, in area of performance measurement "less is better". It is recommended to companies to start with a small number of KPIs which are absolutely necessary to monitor the multilevel processes (*plan, source, make, and deliver*) which they can successfully manage and operate. Another step that would undoubtedly make better review and understanding of KPIs by companies can also be hierarchical organization of those selected KPIs.

3. IMPLEMENTATION OF KPIs IN CONTINUOUS IMPROVEMENT PROCESS

If KPIs are mentioned as one of the crucial tools for process measuring, it is necessary to put them into the larger frame, where the results of the feedback would be significantly more valuable. The main purpose of this article is to introduce and explain the key role of combining mathematics with analysing processes, presented through KPIs, and continuous improvement way of thinking, which allows managers to understand processes and draw essential observations from quantitative data. Process improvement is the continuous methodology with aim, not only to eliminate deviations and non-value added activities, but also to fill in the performance gaps and level all kinds of activities and resources inside the production system (Sutari, 2015).

Approach to Continuous Improvement (CI), as the part of famous Japanese business philosophy, has spawned many various tools which are nowadays the foundations of modern industry world. As initial argument, unavoidable prerequisite for full implementation of CI process is the establishment of self-learning factory. As the concept, it stands for action-oriented approach in which employees (especially shop floor operators which are specialists for line or process stage they are responsible for) are encouraged in development of their own competencies in order to achieve improvements in production methods, reduction of all excessiveness and establishment of Lean production (Cachay & Abele, 2012). Therefore, only fundamental and multi-level system approach, where every single participant, in each company activity, has to leave his mark and impact along the way to some improvement, means that future prosperity lies on the reliable source – developed people. Essential importance of involvement of employees from every company department, and with different professions, will be further explained through particular case.

In theoretic concept of Lean manufacturing, there is present a huge pile of defined tools. Whether we are speaking of quality improvement tools like *Six Sigma* and *Poka-Yoke*, or methods related to time savings like *SMED* (Single Minute Exchange of Dies) or other scheduling methods like bottleneck analysis, all of them have the same unified goal – optimal process (Sundar, Balaji & Kumar, 2014). Even if it is clear that the word "optimum" is just a true north, commitment of every single participant in achieving it, is the promising way for company development. On the other side, repetitive return to the significance of the human role in case of this kind of production is necessity. Success of every senior Lean factory relies on the dedication and perceptions of their workers, no matter if they are called white or blue-collar. Due to that, suggestions,

opinions and ideas of people who are in tight, everyday contact with process itself, are invaluable assets for managers and other decision makers.

All previously presented systematics naturally strive to be composited in some type of process entirety, which, according to the rule of closed circle, need to have iteratively and cyclically type of flow. Similar to the Deming´s PDCA (*Plan-Do-Check-Act*) approach, some theoreticians define DMAIC (*Define, Measure, Analyse, Improve and Control*) model, which is tightly related to Six-Sigma quality concept. According to Gejdoš (2015), DMAIC is "*extended model which refers to a data-driven improvement cycle used for improving, optimizing and stabilizing business processes and designs*". According to both previously mentioned models, it is clearly notable that every sustainable improvement of any performance or process, first need to be decomposed to the exact points which then have to be evaluated, and then every part should be analysed as independent process with own specific characteristics and deviations. In order to minutely present and explain the whole, or some part of the process, there are several commonly used methods. One of the most frequently used is VSM (*Value Stream Mapping*), which relies on wide set of symbols and rules used for their networking (Rohani & Zahraee, 2015). In this way, every deviation would be entirely understandable and therefore attacked straight to the root cause. This kind of approach is one of the basic elements of the Lean production.

After the activities with purpose to define the nature of deviation, and evaluation of its influence on the holistic system picture after that, measuring is the phase which is mostly connected with some kind of calculations. Due to that, crucial point of this task is to segregate the appropriate method or model, which would express the most accurate current state. The most commonly used tool for this purpose, and one way to carry out the monitoring of the production process appropriately, is a control chart. How different types of control charts could be used to monitor different aspects of the production process, will be treated in the following section.

4. DEFINITION AND IMPORTANCE OF CONTROL CHART TOOL

According to the theory, control chart is significantly important tool stem from the wider concept of Statistical process control (SPC). SPC itself is a part of the comprehensive concept of Statistic Quality control (SQC), and its main purpose is analysing and inspecting if the randomly chosen outputs from particular process are within a predetermined range (Reid & Sanders, 2005). Based on the previous phase, management can evaluate stability and performance of the measured process.

Control charts are forms used to gather and describe values, statistical quantities, or production outputs for comparison, with previously established control limits. Initially, control charts are just graphical representation of measured results. Moreover, if the pile of collected observations is recorded over the long period, characteristics and behaviour of the process begin to be recognizable. These kinds of charts are the most frequently used tool in the statistical regulation of processes. Besides the fact that their ability to make impact on process quality, they are considered as a valuable tool for distinguishing random from systematic deviation causes. Due to significantly larger consequences after the special kind of reasons, and their practice to change the attributes of a process, they would be their most important object for measuring. Functioning of the chart systematic is based on samples taken from the process, which is usually taken on the fixed time interspace (Gejdoš, 2015).

The main aim of control charts is to be used in processes of monitoring and performance control. From the moment when deviation appeared, corrective actions are a must, to achieve a better mean value of the process, or to reduce variability of indicators. Visually, chart is presented as a histogram on which, the horizontal axis contains the terms when samplings were noticed, differently from the vertical axis which represents calculated values of the appropriate variables. Also, one of the greatest advantages of control charts is the easiness of use, even to the employees without advanced knowledge and skills in statistics and business analysis (Humble, 1998). Concreteness, time saving, and width of use, make this tool powerful for Continuous improvement methodology in every company.

5. TYPES OF CONTROL CHARTS

Considering dispersion of process variability as a base for analysing reliability of functioning, Range charts (R-charts) are used to secure the reduction of oscillations to the defined scope. For appropriate monitoring and process tracking, it is essential to establish upper and lower control limits, which could signal and separate special from the common deviation causes. Keeping indicator values within the defined scope will lead company to the crucial business stability. As an illustration, situation when there is at least one measured range outside the upper control limit, or there is specific upward trend of indicator within the

control limits, process variability then has increasing trend. The fundament of continuous improvement methodology lies into the constant and iterative reduction of the variance.

As the main characteristic of R chart, difference between the maximum and minimum value of the measures in each period, should be calculated and divided to the number of observations. Consequently, the aim of every company is to stabilize each part of the process, and that stabilization is expressed through narrower interval of limits. Only when the company reaches the moment when process flow is stable enough and stated between the limits, it is suitable for them to apply another type of control chart.

The second type used during analysis is based on the mean of the gathered data. Therefore, theoretical titles for this kind of charts are "mean" or "X-bar" charts. Initial step of developing this methodology is based on calculating mean value of all measured observations. Then, for the purpose of accessing to a holistic view of organization process, average value is drawn from all individual mean values related to different moments in time (1).

$$\bar{\bar{x}} = \frac{\bar{x}_1 + \bar{x}_2 + \cdots + \bar{x}_N}{N} \tag{1}$$

Similar to the R-charts, it is important step to set both limits (2) as a border in which, process variables must be integrated. In this type of chart, they are calculated in the following way:

$$\begin{aligned} \text{Upper control limit (UCL)} &= \bar{\bar{x}} + z\delta_{\bar{x}} \\ \text{Lower control limit (LCL)} &= \bar{\bar{x}} - z\delta_{\bar{x}} \end{aligned} \tag{2}$$

If symbol *z* is representing standard normal variable, which could lead to the specific level of certainty (2 for 95.44% confidence, 3 for 99.74%), variable δ stands for standard deviation of the distribution of sample means. Otherwise, usually practical way of calculating limits is based on multiplying $\bar{\bar{x}}$ with 0.9 or 1.1, that expresses increasing or reducing it by 10%.

It is crucial to emphasize that this type of chart should be used only when the fluctuations of the process variables are within the defined limits. This trait derives from the nature of mean method, which is quite unreliable in cases of often oscillations.

6. CASE OF OEE INDICATOR

Overall Equipment Effectiveness (OEE) represents a metric that is used to identify the percentage of planned production time that company exploits during the shifts. OEE score which is equal to 100% is considered as the true north state with manufacturing only good parts, as fast as possible, with no time losses. Three essential factors that constitutes OEE indicator are: Availability, Performance, and Quality. Each of them expresses different view on the types of deviations, which can be solved in order to close gaps and improve process (Puvanasvaran, Mei & Alagendran, 2013).

Availability as a parameter of OEE indicator refers to the percentage number that presents time availability of machine when there is production need for it. Difference in time between total production time and time shown by this parameter, is caused by breakdowns, setups and adjustments. Calculation (4) is given in following:

$$\text{Availability} = \frac{\text{Actual Production Time}}{\text{Planned Production Time}} \tag{4}$$

Performance efficiency (5), as sub-indicator, is used to express decreases of availability time by different causes of small disruptions (cleaning, checking, and jam) and reduced production speed (equipment wear, operator inefficiency). It takes in consideration actual and ideal run rate in order to show real equipment efficiency.

$$\text{Performance} = \frac{\text{Current Run Rate}}{\text{Ideal Run Rate}} \tag{5}$$

The quality rate (6) defines the accuracy of the process. It is used to show, how many of total production pieces, are in accordance with quality standards and principles. It is extremely important to reduce scrap and inappropriate parts by setting continuous improvement tools (e.g. Poka-Yoke). These results will have crucial impact, first on quality parameter, and the whole OEE indicator, too.

$$\text{Quality} = \frac{\text{Good Pieces}}{\text{Total Pieces}} \tag{6}$$

Combining these three previously mentioned variables, OEE indicator (7) would be the result of the following calculation:

$$OEE = \text{Availability} * \text{Performance} * \text{Quality} \tag{7}$$

For the purpose of this analysis, example of the fictive, manufacturing-oriented company is used to accurately represent importance and expediency of OEE implementation and tracking. Period that has been considered for making analysis and conclusions derived in this paper, is defined as one-year monthly based period.

Elements of production that were involved in the calculation include shift length, breaks, downtime, ideal cycle time, total parts and scraped parts. Combining these several variables, it is aimed to present how appropriate implementation and usage of control charts, will provide company with stability and improvement impacts on all its processes.

In the following table will be presented the calculation of OEE for one-month period:

Table 1: Input data for OEE calculation

Item	Data
Shift Length	8 hours
Breaks	1 hours
Down Time	1.25 hours
Ideal Cycle Time	12 seconds
Total Count	1580 pc
Reject Count	110 pc

According to the inputs in Table 1, and presented formulas (4,5,6 and 7) for individual indicators, achieved results are presented below in Table 2:

Table 2: OEE calculation

Item	Data
Availability	82.14%
Performance	91.59%
Quality	93.03%
OEE	**69.98%**

As the conclusion of the highlighted example, it could be noticed that only one parameter below the target level could cut down the holistic score regarding OEE. In this case, huge influence is observed by the variable availability score, which is caused by increased participation of breakdown time in total production time. Therefore, the first advice that could be given to the company is to work continuously on productivity and time usage improvement.

By application of the same method as above, calculation lead to the overall OEE results for all further months of the particular year. For the purpose of this paper, two types of control charts were used (X-bar chart and R-chart) within the simulation algorithm to properly analyse impacts of different production elements on the value of OEE indicator and process itself.

Simulation conclusions would be analysed in two different ways. First one is presented on the R-chart and refers to the diversity of different samples that were noticed during one month. As it was highlighted before, the main significance of the R-chart is to show if differences in measurement result in each period are within the set target scope.

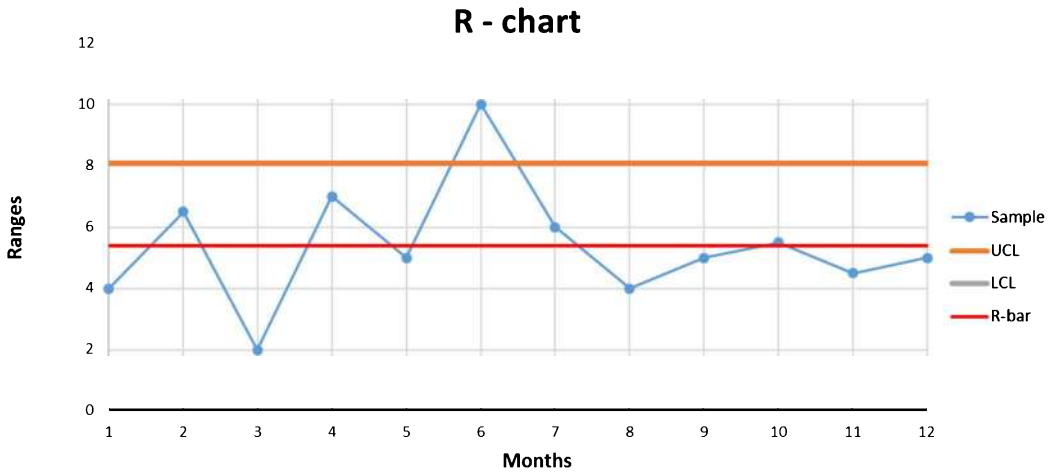


Figure 1: R - chart on example of OEE indicator

The graph above shows importance of accurate control and adequate influence on production process according to the OEE oscillations. As it is noticed in the first six months, there are huge variations in gathered data values between consecutive months. In the sixth month, value of the indicator is rocketed high and above the set upper limit. That signals that the production process of the company faced unusual special cause, which must lead to the investigation, analysis, and corrective actions.

It is important to emphasize that every company department and all employees of all levels of hierarchy, must be completely involved in the process of monitoring and stabilization of this essential process traits. For the reduction of the OEE within the framework defined by the control limits, all of its parameters must be thoroughly analysed. Seeing that the OEE is a too complex and comprehensive variable, it must be "attacked" from the several different aspects. For this purpose, suggested way for improving the whole results is to track and constantly improve the individual values of availability, performance, and quality of the "tools" to make a bigger impact on the future stability of the compound OEE variable.

As the responsible department for working on the boosting the performance sub-indicator, could be mentioned the production department itself, which has to secure appropriate ergonomic conditions, in order to reduce the ideal cycle time per part/product. In this task, they must have support from the company's technicians.

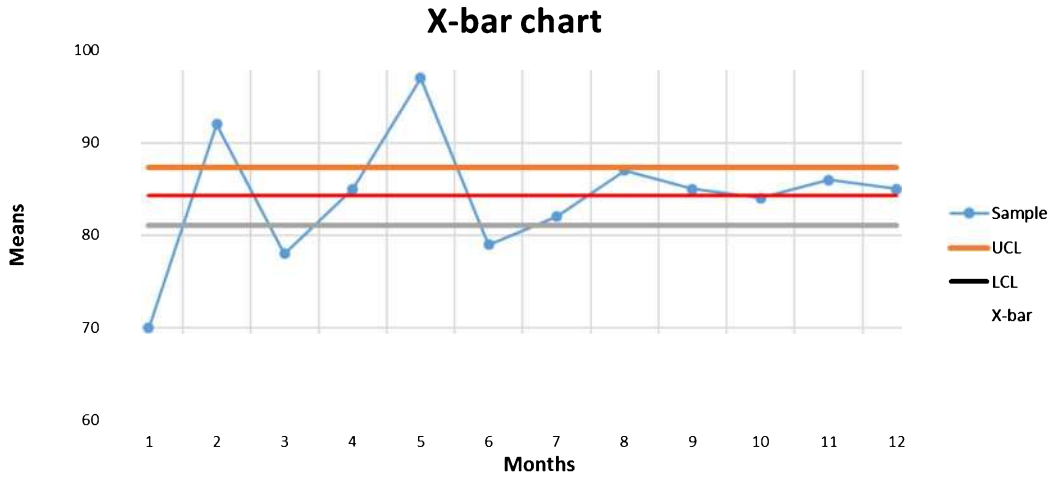


Figure 2: X-bar chart

Quality sub-indicator refers to the reducing of scrap and inappropriate production parts, as well as the early revealing of the damaged parts delivered from the suppliers. With the previous, quality department fulfils all necessary standards for deviations prevention in order to secure smooth process flow.

Availability is connected with organizational harmoniousness and it is responsibility of every company's department to work on it. With more minutes or seconds for value added activities, company has a good base to be stronger competitive in the market race.

As the previously highlighted measures and required approach were implemented, variations of observed variable are reducing. For every company, this is a precondition for a timely application of X-bar chart. It distinctly presents variations between monthly measured averages of taken samples, and represent the basis for stability of variable first, and then of the whole process, too.

In the graph above, impact of corrective actions by different company's departments could be clearly identified. In first half of the year, value of OEE indicator is almost always outside defined limits, and during this period, application of X-bar chart is worthless. When impacts on process are made, X-bar chart becomes a powerful tool, which, if it is used properly, provides crucial process consistency and gives significant benefits to the whole company's business.

Finally, it is important to emphasize that stable and precisely defined process provides significant certainty to all departments, referring to every process performance, and consequently, to all tasks that they should accomplish.

7. CONCLUSION

As has been noted, the present research aimed at investigating and emphasizing of essential impact that continuous improvement tools have on the frame of production process performances. In addition, it is presented how crucial is the appropriate usage of the key performance indicators in order to extract maximum utilizable information from its rigidly quantitative essence. For this purpose, simulation was conducted over the data of the fictive manufacturing company with combined methodology based on X-bar and R control charts.

The results of this study could be used in further research, both for operations managers in companies and scholars, due to its wide applicability in field of industrial engineering. Besides the limitation of the study caused by its basing on the simulation and data of the fictive company, all implemented tools, management advice and conclusions are derived from the analyses of the many real company case studies. Taking into account common causes of inappropriate asset utilization and all other deviations, this paper was attempted to explain methods, which could be easily used even by the non-engineers.

Further research in this field of study should focus deeper on developing and combining new types of control charts, as well as on possibilities for its application in other areas of production and operations management. Consequently, many other production losses could be deeply investigated and reduced, taking into account the reliable support provided by statistical methods and models.

REFERENCES

Cachay, J., & Abele, E. (2012). Developing Competencies for Continuous Improvement Processes on the Shop Floor through Learning Factories–Conceptual Design and Empirical Validation. Procedia CIRP, (3), 638-643.

Gejdoš, P. (2015). Continuous Quality Improvement by Statistical Process Control. Procedia Economics and Finance, 34, 565-572.

Humble, C. (1998). Caveats regarding the use of control charts. Infection control and hospital epidemiology, 865-868.

Jevgeni, S., Eduard, S., & Roman, Z. (2015). Framework for Continuous Improvement of Production Processes and Product Throughput. Procedia Engineering, 100, 511-519.

Lindberg, C. F., Tan, S., Yan, J., & Starfelt, F. (2015). Key Performance Indicators Improve Industrial Performance. Energy Procedia, 75, 1785-1790.

Parmenter, D. (2015). Key performance indicators: developing, implementing, and using winning KPIs. John Wiley & Sons, 1-19.

Puvanasvaran, A. P., Mei, C. Z., & Alagendran, V. A. (2013). Overall equipment efficiency improvement using time study in an aerospace industry. Procedia Engineering, 68, 271-277.

Reid, R. D., & Sanders, N. R. (2005). Operations management: an integrated approach. Hoboken, NJ: John Wiley

Rohani, J. M., & Zahraee, S. M. (2015). Production Line Analysis via Value Stream Mapping: A Lean Manufacturing Process of Colour Industry. Procedia Manufacturing, 2, 6-10.

Sundar, R., Balaji, A. N., & Kumar, R. S. (2014). A Review on Lean Manufacturing Implementation Techniques. Procedia Engineering, (97), 1875-1885.

Sutari, O. (2015). Process Improvement Using Lean Principles on the Manufacturing of Wind Turbine Components–a Case Study. Materials Today: Proceedings, 2(4), 3429-3437.

A NOVEL ALGORITHM FOR COMBINATORIAL PROBLEM IN MANUFACTURING CELL FORMATION

Miloš Danilović*[1], Oliver Ilić[1],
[1]Faculty of Organizational Sciences, Belgrade, Serbia
*Corresponding author, e-mail: danilovicm@fon.bg.ac.rs

Abstract: *In this paper we consider machine and part family grouping for cell formation. Manufacturing cell formation is the first and foremost issue in designing cellular manufacturing systems. The primary objective of this step is to cluster machines into machine cells and parts into part families so that the minimum of intercell trips will be achieved. For this purpose, the Generalized Constructive Algorithm is applied for solving the combinatorial optimization problem in manufacturing cell formation. The objective is to maximize the sum of similarity coefficients between machine/part pairs. This formulation is suitable for effective narrowing of the feasible solution set. A parameter determining the precision of the search of the feasible solution set is introduced. The Generalized Constructive Algorithm constructs a solution population from the feasible set. The initialization phase of the Generalized Constructive Algorithm utilizes the advantages provided by the definition of the objective function. Experimental evaluation confirms the advantages of the proposed approach regarding known results.*

Keywords: *group technology, similarity measure, constructive algorithm, cluster analysis*

1. INTRODUCTION

Group technology is an approach that identifies attributes of the population suitable for grouping its members into groups, or families (Ilić 2015). Cellular manufacturing is an application of group technology in manufacturing in which all, or a portion, of a firm's manufacturing system has been converted into cells. The layout of a facility contributes significantly to the speed of product throughput achieved by the facility. Cell formation can be defined as grouping the parts into part families, and the machines into machine cells, and then assigning the part families into corresponding machine cells. Thus, the Cell Formation Problem (CFP) can be defined as a problem of grouping machines into groups that minimizes the number of parts to be processed on machines from different groups. CFP is known as an NP-hard problem, due to its computational complexity.

This paper proposes a method based on the definition of the problem in Ilić (2014), where the optimization procedure is carried out by applying the Generalized Constructive Algorithm (GCA), shown in (Danilović and Ilić 2013, 2016). In Ilić (2014), the proposed objective function takes into account only the neighbor elements in the permutation of machines and parts. Thus defined objective function opens up great possibilities for the implementation of the optimization process. Limiting the mutual influence only to neighbor elements in the permutation allows defining the rules that significantly reduce the feasible solution set. These rules are formulated through five lemmas, presented in the Section 4.

The research, presented in this paper, is focused to the improvement of the procedure of determining the optimal arrangement of machines and parts, assuming that the cell formation is conducted in the same manner as in Ilić (2014). The suitability of the formulation of the problem in Ilić (2014) allows that the initial arrangement, *i.e.* the first phase of GCA, is applied after narrowing the feasible solution set (Danilović and Ilić 2016a). This significantly increases the efficiency of the process, what's more, in that way specific instances can be solved using exact procedures.

The paper is organized as follows. After the introduction, Section 2 presents related works. The problem formulation is given in Section 3. In Section 4 five lemmas are proven which enable narrowing of the feasible solution set. The hypothesis that defines the precision of the search of the feasible solution set is stated. The proposed procedure is presented in Section 5, while the comparison of the proposed approach with the program PFAST is given in Section 6. Concluding remarks and directions of future research are given at the end of the paper.

2. LITERATURE REVIEW

Due to its importance in the design of cellular manufacturing systems, the CFP has been given considerable attention in literature. There have been many different approaches and practical researches conducted on the CFP (Yin et al. 2005; Hachicha et al. 2008; Pattanaik and Sharma 2009). A comprehensive review of CFP approaches is given in Singh (1993). Extended reviews of the various approaches are available in the literature (Reisman et al. 1997; Selim et al. 1998; Papaioannou and Wilson 2010).

Most CFP methods in the literature assume that parts have only a unique process routing. Also, in most of the studies, cell formation is performed assuming all machines to be reliable (Jabal-Ameli and Akart 2008). Machine-component Group Analysis (MCGA) is based on Production Flow Analysis (Burbidge 1977). In MCGA-based methods, machine-component groups are formed by permuting rows and columns of the machine-component chart in the form of a zero-one matrix. Rank Order Clustering (ROC) (King 1980) is a simple algorithm used to form a machine-part group. The algorithm is based on the sorting rows and columns of the machine-part incidence matrix. A Direct Clustering Algorithm (Chan and Milner 1982) sorts the total number of 1's in each row and column in increasing and decreasing order to form the clusters. MODROC algorithm, developed by Chandrasekharan and Rajagopalan (1986) offers improvements over ROC.

Similarity coefficient-based approaches are distinguished from the other approaches by their flexibility in incorporating various types of manufacturing data into the CFP, and suitability for development software tools. A number of similarity coefficients have been analyzed and proposed in literature (Yin and Yasuda, 2005; Yin and Yasuda, 2006). Among various similarity coefficients, Jaccard similarity coefficient was the most used in literature and the most stable similarity coefficient (Yin and Yasuda, 2005). Oliveira, et al. (2008) reviewed 8 different similarity coefficients. Four of them are Jaccardian and the rest are non-Jaccardian coefficients. They concluded that the one similarity coefficient can be chosen over others according to the preference of the cell formation. For example, if the fewest intercell flows is the main focus, McAuley's Jaccardian coefficient should be used. Also, McAuley's Jaccardian coefficient is preferred when the strength of clustering is the key factor of judging the quality of a solution. Similarity coefficient-based approaches have been widely used since McAuley (1972) for the first time combining the Jaccard similarity coefficient with the Single Linkage Cluster analysis, which was resulted in construction of a tree called a dendrogram. This was followed by development of other similarity coefficient-based approaches. Recently, the Cluster Analysis (CA) was discussed and attention was drawn to the main decisional step of CA based on similarity coefficient methods (Manzini, et al., 2010). One group of researchers used similarity coefficient-based method for generating a good initial solution for CFP (Wu, et al., 2009; Chung, et al., 2011). An e-Learning tool considering similarity measures is presented by Ilić (2014).

3. PROBLEM FORMULATION

Similarity coefficient represents a measure of similarity between machines/parts which is used to group them together. The value of the similarity coefficient usually ranges from 0 to 1. If this value is equal to 0, there is no similarity between two machines/parts. Conversely, as this value is closer to 1, the two machines/parts are more similar.

The similarity coefficient between machine *i* and machine *j* is defined as the ratio of the number of parts visiting both machines and the number of parts visiting one of the two machines as follows:

$$s_{ij}^{M} = \frac{a_{ij}^{P}}{a_{ij}^{P} + b_{ij}^{P} + c_{ij}^{P}}; \quad 0 \le s_{ij}^{M} \le 1 \tag{1}$$

where a_{ij}^{P} is the number of parts that visit both machines *i* and *j*; b_{ij}^{P} is the number of parts that visit machine *i* but not *j*; c_{ij}^{P} is the number of parts that visit machine *j* but not *i*.

The similarity coefficient between part *k* and part *l* is:

$$s_{kl}^{P} = \frac{a_{kl}^{M}}{a_{kl}^{M} + b_{kl}^{M} + c_{kl}^{M}}; \quad 0 \le s_{kl}^{P} \le 1 \tag{2}$$

where a_{kl}^M is the number of machines used by both parts *k* and *l*; b_{kl}^M is the number of machines used by part *k* but not *l*; c_{kl}^M is the number of machines used by part *l* but not *k*.

The optimisation procedure for machines finds the permutation $(\pi_1,...,\pi_m)$ of machine labels (1,..,*m*), which maximizes value $\sum_{i=1}^{m-1} s_{\pi_i\pi_{i+1}}^M$.

The optimisation procedure for parts finds the permutation $(\Pi_1,...,\Pi_n)$ of part labels (1,..,*n*), which maximizes value $\sum_{k=1}^{n-1} s_{\Pi_k\Pi_{k+1}}^P$.

A deterministic combinatorial optimization problem may be formulated as a quadruple (*I*, *F*, *C*, *g*), where:

- *I* is a given instance of the combinatorial optimisation problem;
- *F*(*I*) is the finite set of feasible solutions for a given instance *I*;
- *C*(*x*), $x \in F(I)$, denotes a real-valued objective function, which is a measure of the feasible solution *x*;
- *g* is the goal function, and is usually "min" or "max".

The goal is then to find, for a given instance *I*, an *optimal solution*, that is, a feasible solution *x* with:
$C(x) = g\{C(x') \mid x' \in F(I)\}$

In the significant number of combinatorial optimisation problems (scheduling problems, routing problems, assignment problems) $I = O^n = \{o_1,...,o_n\}$ is a set of *n* objects, each having defined properties and $F(O^n)$ can be formalized by different sequences of these objects. The selection of objects and the order of objects in a sequence determine the corresponding *C* value. Let $PR^n = \{pr_1,...,pr_n\}$ denote a set of object properties (pr_i are properties of object o_i). The set of given objects O^n can be defined formally, without loss of generality, as a bijection from the set S^n={1, 2,..., *n*} to O^n. In that way, *I* can be represented by PR^n, and $F(O^n)$ can be represented by permutations π^n of S^n. Heuristics for solving these problems differ only by the manner in which they form the permutations and the criteria for the selection of desirable permutations.

Constructive search techniques work by constructing a solution step by step, evaluating that solution for feasibility and objective function. Insertion based constructive heuristics typically have common structures, comprising the *initialization* phase and the loop in the *insertion* phase. In the initialization phase, the selection function $f_1(PR^n)$ determines an integer e_1 from S^n, that will be included into the solution *x*. The insertion phase has *n*-1 iterations, such that, at the beginning of the *k*-th iteration, S^n is partitioned into two subsets: $PRT^2(S^n) = (PRT_1^k(S^n), PRT_2^{n-k}(S^n)) = (A_1^k, A_2^{n-k})$.

At each iteration *k* of the insertion phase, two types of selections are performed: a selection $f_2(PR^n, k, A_2^{n-k})$ of the integer e_{k+1} from A_2^{n-k} to be removed from A_2^{n-k} and the selection $f_3(PR^n, k, e_{k+1}, \rho^k[A_1^k])$ of the position *l* in $\rho^k[A_1^k]$ where e_{k+1} will be inserted. Performed insertion uniquely determines the arrangement of integers in $\rho^{k+1}[A_1^{k+1}]$.

GCA may be defined as a function $x \leftarrow CA(PR^n, F, C, g, f_1, f_2, f_3, ARG)$, where $ARG = \{\boldsymbol{arg}_1,...,\boldsymbol{arg}_7\}$ is the set of seven optional arguments. In this research, only $\boldsymbol{arg}_4$ having value R_1 is considered, *i.e.* algorithm tracks simultaneously all partial permutations that result in current optimal value of the objective function.

4. NARROWING THE FEASIBLE SET

The proposed similarity coefficient objective function takes into account only the neighbor elements in the permutation of machines and parts. Limiting the mutual influence only on neighbor elements in the permutation allows defining the rules that significantly reduce the feasible solution set. These rules are formulated through five lemmas, stated in this Section. As there is a direct analogy between the optimization

of machine arrangement and arrangement of parts, the remainder of this paper considers only the optimization for machines.

Lemma 1 (Symmetric solution): Each optimal solution has its symmetric solution that is also optimal; symmetric solution is obtained by reversing the original permutation.

The proof of this Lemma is obvious. Since the value of the objective function is obtained summing similarity coefficients of the neighbor elements in the permutation, same value is obtained if the summands are reversed.

Lemma 2 (Complete matching): If $s_{ij}^{M} = 1$, the position of machine *i* in the optimal permutation is next to the position of machine *j*.

Lemma 3 (Transition): If $s_{ij}^{M} = 1$ and $s_{jk}^{M} = 1$, then $s_{ik}^{M} = 1$.

Lemma 4 (Group matching): If a subset of machines has mutual similarity coefficient equal to 1, every permutation of these machines within the entire permutation results in the same value of the objective function.

The proof of these Lemmas can be derived as follows: The value of the objective function is obtained by summing only the similarity coefficients of neighboring machines in the permutation. Suppose, without loss of generality, that the machines *i* and *j* have a similarity coefficient equal to 1, and that all other coefficients are less than one. Suppose that, in the first case, the optimal partial sequence of machines is *k i j l,* and in the second case *k i q j l.* The similarity coefficient for machines *i* and *q* is less or equal than the similarity coefficient for machines *i* and *k*, otherwise *k i j l* is not the optimal permutation. In the same way, the similarity coefficient for machines *j* and *q* is less or equal to the similarity coefficient for machines *j* and *l*. Thus, the summand, having value 1, is in the second case replaced with the summand with the value less than 1; the added summand in the second case is less or equal to the corresponding summand in the first case. This completes the proof of the Lemma 2. Accordingly, proofs of Lemma 3 and Lemma 4 are straightforward.

The conclusions of these Lemmas can be extended to the cases where the similarity coefficients are not equal to one.

Lemma 5 (Clustering): If the subset of machines has all of their mutual similarity coefficients greater than x, and if all the other similarity coefficients are less than x, in the optimal permutation all those machines belong to the same compact group. Mutual arrangement of machines within this group will match the permutation of the group that has the largest partial value of the objective function.

The proof of this Lemma is analogous to the previous proof.

It is clear that the obtained conclusions may define the procedures which significantly reduce the feasible solution set. While the first four lemmas imply exact reduction of the feasible set, Lemma 5 implies the possibilities for the near optimal reduction of the feasible set. Figure 1 presents an agglomerative cluster dendrogram representing similarity of machines A, B, C, D, E, F and G.

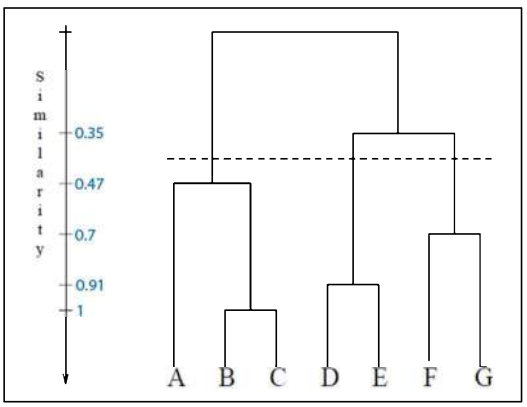


Figure 1: Agglomerative cluster dendrogram

According to Lemma 2, machines B and C, having similarity coefficient equal to 1, are always neighbors in optimal permutations. According to Lemma 5, if the precision parameter is 0.8, two clusters, {B,C} and {D,E} are constructed (D and E have the similarity coefficient 0.91 which is greater than 0.8). If the precision parameter is 0.5, three clusters, {A,B,C}, {D,E} and {F,G} can be constructed.

5. THE NOVEL ALGORITHM

The adopted objective functions and the pre-defined level of clustering are the ideal conditions to define the arrangement that provides the initial phase of the GCA. Since the GCA can simultaneously track multiple initial permutations, it can be formally defined as:

$$x \leftarrow CA(PR^n, F, C, g, f_1, f_2, f_3, \boldsymbol{arg}_4 = R_1). \tag{3}$$

This definition also allows a trivial application of parallel programming, because the individuals in the initial population can be treated completely independently of each other. The initial grouping and arrangement can be summarized through five steps:

Step 1. Each group of machines having all similarity coefficients equal to 1 are replaced with a single, arbitrarily selected machine from the group.
Step 2. Define the parameter $p \leq 1$.
Step 3. Apply the cluster algorithm so that the lowest similarity coefficient in each of the clusters is greater than or equal to *p*. Let y_q denote the lowest similarity coefficient in the *q*-th cluster (if the machine does not belong to any cluster, the corresponding value is equal to its largest similarity coefficient).
Step 4. Sort clusters according to non-increasing values of y_q.
Step 5. Determine the permutations of machines in each cluster that provide the greatest values of the objective function. Let z_q denote the optimal number of partial permutations within the *q*-th cluster. Any combination of the obtained optimal partial permutations determines an initial arrangement for the GCA. In the insertion phase of GCA, each cluster is treated as one element in the permutation. When the *k*-th iteration determines the permutation of length *k*, each cluster in the permutation is replaced with its elements.

Even before the experimental verification of the proposed approach, certain benefits are obvious. Although the proposed approach does not guarantee the optimal value of the objective function, it enables an efficient processing, due to an important fact: the number of steps of the algorithm is predefined with only two variables, *m* and *p*, so the user is informed in advance precisely what will be the consumption of CPU time. In this way, the user can adjust the search precision to the available computer time, *i.e.* to choose the greatest possible value for p.

6. EXPERIMENTAL RESULTS

The quality and efficiency of the proposed procedure are verified on the example, which is discussed in Ilić (2014), and Ilić and Cvetić (2014). In these researches, the results are compared with the results of Irani, *et al.* (2000), Irani and Huang (2005), and Irani (2012), obtained by the software package PFAST. Table 1 illustrates the process paths for 19 parts on 12 machines.

Table 1: Routing sheet

1	1	4	8	9			
2	1	4	7	4	8	7	
3	1	2	4	7	8	9	
4	1	4	7	9			
5	1	6	10	7	9		
6	6	10	7	8	9		
7	6	4	8	9			
8	3	5	2	6	4	8	9
9	3	5	6	4	8	9	
10	4	7	4	8			
11	6						
12	11	7	12				
13	11	12					
14	11	7	10				
15	1	7	11	10	11	12	

16	1	7	11	10	11	12	
17	11	7	12				
18	6	7	10				
19	12						

Based on the above routing sheet, similarity matrices for machines and parts are shown in Table 2 and Table 3 respectively. The diagonal elements are marked in grey, indicating the only elements that contribute to the value of the objective function. The bold marked elements of the matrix are the elements having the value above the stated threshold, which is 0.7 for both, machines and parts.

Table 2: Similarity coefficients for machines

	1	2	3	4	5	6	7	8	9	10	11	12
1		0.125	0	0.364	0	0.077	0.462	0.25	0.364	0.3	0.182	0.182
2			0.333	0.25	0.333	0.125	0.077	0.25	0.25	0	0	0
3				0.25	**1**	0.286	0	0.25	0.25	0	0	0
4					0.25	0.25	0.25	**0.78**	0.6	0	0	0
5						0.286	0	0.25	0.25	0	0	0
6							0.188	0.364	0.5	0.3	0	0
7								0.25	0.25	0.5	0.385	0.286
8									0.6	0.077	0	0
9										0.167	0	0
10											0.333	0.2
11												**0.71**
12												

Table 3: Similarity coefficients for parts

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1																			
2	0.6																		
3	0.667	0.667																	
4	0.6	0.6	0.667																
5	0.286	0.286	0.375	0.5															
6	0.286	0.286	0.375	0.286	0.667														
7	0.6	0.333	0.429	0.333	0.286	0.5													
8	0.375	0.222	0.444	0.222	0.2	0.333	0.571												
9	0.429	0.25	0.333	0.25	0.222	0.375	0.667	0.857											
10	0.4	**0.75**	0.5	0.4	0.143	0.333	0.4	0.25	0.286										
11	0	0	0	0	0.2	0.2	0.25	0.143	0.167	0									
12	0	0.167	0.125	0.167	0.143	0.143	0	0	0	0.2	0								
13	0	0	0	0	0	0	0	0	0	0	0	0.667							
14	0	0.167	0.125	0.167	0.333	0.333	0	0	0	0.2	0	0.5	0.25						
15	0.125	0.286	0.222	0.286	0.429	0.25	0	0	0	0.143	0	0.6	0.4	0.6					
16	0.125	0.286	0.222	0.286	0.429	0.25	0	0	0	0.143	0	0.6	0.4	0.6	**1**				
17	0	0.167	0.125	0.167	0.143	0.143	0	0	0	0.2	0	**1**	0.667	0.5	0.6	0.6			
18	0	0.167	0.125	0.167	0.6	0.6	0.167	0.111	0.125	0.2	0.333	0.2	0	0.5	0.333	0.333	0.2		
19	0	0	0	0	0	0	0	0	0	0	0	0.333	0.5	0	0.2	0.2	0.333	0	

The values of the objective functions for these arrangements of machines and parts are 3.496 for machines and 8.632 for parts. For the stated tresholds of 0.7, three clusters are identified for machines and four clusters for parts. Clusters for machines are {3,5}, {4,8} and {11,12}, clusters for parts are {15,16}, {12,17}, {8,9} and {2,10}. These clusters narrow feasible sets: from 12! to 2!2!2!9! for machines, and from 19! to 2!2!2!2!15! for parts. Thus, total search can be applied to obtain solution for machines, while GCA should be

applied to obtain results for parts. Total search for machines results in four (2 symmetric) optimal arrangements, having 5.87 as the value of the objective function. These arrangements are shown in Table 4.

Table 4: Optimal arrangements of machines

	1	2	3	4	5	6	7	8	9	10	11	12
1	12	11	10	7	1	4	8	9	6	3	5	2
2	2	3	5	6	9	8	4	1	7	10	11	12
3	12	11	10	7	1	4	8	9	6	5	3	2
4	2	5	3	6	9	8	4	1	7	10	11	12

Arrangement 4 is symmetric to arrangement 1, while arrangement 3 is symmetric to arrangement 2. When GCA is applied for parts, 16 (8 symmetric) optimal arrangements are obtained, with 11.418 as the value of the objective function. These arrangements are shown in Table 5.

Table 5: Optimal arrangements of parts

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	11	8	9	7	1	3	4	2	10	6	5	18	14	15	16	12	17	13	19
2	11	8	9	7	1	4	3	2	10	6	5	18	14	15	16	12	17	13	19
3	11	8	9	7	1	3	4	2	10	6	5	18	14	16	15	12	17	13	19
4	11	8	9	7	1	4	3	2	10	6	5	18	14	16	15	12	17	13	19
5	11	8	9	7	1	3	4	2	10	6	5	18	14	15	16	17	12	13	19
6	11	8	9	7	1	4	3	2	10	6	5	18	14	15	16	17	12	13	19
7	11	8	9	7	1	3	4	2	10	6	5	18	14	16	15	17	12	13	19
8	11	8	9	7	1	4	3	2	10	6	5	18	14	16	15	17	12	13	19

The lower threshold implies reduced processing time with the possibility of worse objective function values. To investigate that, the threshold of 0.66 is stated for the optimization of the arrangement of parts. Five clusters are obtained: {14,15}, {16,17,18}, {2,3,4}, {5,6,7,8,9} and {10,11}. This grouping reduces the size of the feasible solution set from 19! to 2! 3! 3! 5! 2! 9!. It is interesting that despite the significant reduction in the feasible solution set, and significant savings in CPU time, GCA provides optimal results identical to the previous experiment, when the threshold was 0.7.

7. CONCLUDING REMARKS

This paper presents a procedure for arrangement of machines and parts in the process of cell formation. The objective is to determine the arrangements that maximize the objective function, proposed in Ilić (2014). It is shown that GCA is extremely suitable as an optimization heuristic because its initialization phase can utilize the advantages provided by such a defined objective function with some modifications in the cluster process. Specifically, applied definition of objective function allows simple clustering of machines and parts and the introduction of the precision parameter for the GCA search. Experimental results clearly show that such a defined GCA provides optimal results on the observed test instances with significant saving of the CPU time.

Future research should be directed towards the application of the obtained results when objective functions, extended from the definition in Ilić (2014), are applied. Namely, it is possible that a certain problem requires the involvement of the influence of non-adjacent elements in the permutation on the value of the objective function. However, also in these cases, the former results should be unavoidably used. Information obtained by using the objective function in Ilić (2014) is valuable for narrowing the feasible solution set for any objective function applied.

REFERENCES

Burbidge, J. L. (1977). A manual method for production flow analysis. *Production Engineer*, *56*, 34–38.

Chan, H. M., & Milner, D. A. (1982). Direct clustering algorithm for group formation in cellular manufacture. *Journal of Manufacturing Systems*, *1*(1), 65–75.

Chandrasekharan, M. P., & Rajagopalan, R. (1986). MODROC: An extension of rank order clustering for group technology. *International Journal of Production Research*, *24*, 1221–1233.

Chung, S.-H., Wu, T.-H., & Chang, C.-C. (2011). An efficient tabu search algorithm to the cell formation problem with alternative routings and machine reliability considerations, *Computers and Industrial Engineering*, *60*(1), 7–15.
Danilović, M., & Ilić, O. (2013). Nova formalizacija i proširenje faze umetanja u NEH heuristici. YUINFO - Kopaonik, 304–309.
Danilović, M., & Ilić, O. (2016). A generalized constructive algorithm using insertion-based heuristics. *Computers & Operations Research 66,* 29–43.
Danilović, M., & Ilić, O. (2016a). Generalizovani konstruktivni algoritam za formiranje proizvodnih ćelija. YUINFO - Kopaonik, 169–174.
Hachicha, W., Masmoudi, F., & Haddar, M. (2008). Formation of machine groups and part families in cellular manufacturing systems using a correlation analysis approach. *International Journal of Advanced Manufacturing Technology*, *36*, 1157–1169.
Ilić, O. (2014). An e-Learning tool considering similarity measures for manufacturing cell formation. *Journal of Intelligent Manufacturing*, *25*(3), 617–628.
Ilić, O. (2015). Computer integrated manufacturing, Faculty of Organizational Sciences, University of Belgrade, Belgrade (In Serbian).
Ilić, O., & Cvetić, B. (2014). A comparative case study of e-learning tools for manufacturing cell formation. *Journal of Advanced Mechanical Design, Systems, and Manufacturing, 8*(3)*,* 1–15.
Irani, S. A., & Huang, H. (2005). *Hybrid cellular layouts: New ideas for design of flexible and lean layouts for jobshops*. Columbus: Department of industrial, welding and systems engineering, The Ohio State University.
Irani, S.A. PFAST. (online), (2012). <http://pfast.ise.ohio-state.edu/pfast/BuyPFast.html>, (accessed on 10 December 2012).
Irani, S.A., Zhang, H., Zhou, J., Huang, H., Udai, T.K., & Subramanian, S. (2000). Production flow analysis and simplification toolkit (PFAST), *International Journal of Production Research*, *38*(8), 1855–1874.
Jabal-Ameli, M. S., & Akart, J. (2008). Cell formation with alternative process routings and machine reliability consideration. *International Journal of Advanced Manufacturing Technology*, *35*, 761–768.
King, J. R. (1980). Machine-component grouping in production flow analysis: An approach using rank order clustering algorithm. *International Journal of Production Research*, *18*, 213–232.
Manzini, R., Bindi, F., & Pareschi, A. (2010). The threshold value of group similarity in the formation of cellular manufacturing systems. *International Journal of Production Research*, *48*(10), 3029–3060.
McAuley, J. (1972). Machine grouping for efficient production. *Production Engineer*, *51*, 53–57.
Oliveira, S., Ribeiro, J. F. F., & Seok, S. C. (2008). A comparative study of similarity measures for manufacturing cell formation. *Journal of Manufacturing Systems*, *27*(1), 19–25.
Papaioannou, G., & Wilson, J. M. (2010). The evolution of cell formation problem methodologies based on recent studies (1997–2008): Review and directions for future research. *European Journal of Operational Research*, *206*(3), 509–521.
Pattanaik, I. N., & Sharma, B. P. (2009). Implementing lean manufacturing with cellular layout: A case study. *International Journal of Advanced Manufacturing Technology*, *42*, 772–779.
Reisman, A., Kumar, A., Motwani, J., & Cheng, C. (1997). Cellular manufacturing: A statistical review of the literature. *Operations Research*, *45*, 508–520.
Selim, H. M., Askin, R. G., & Vakharia, A. J. (1998). Cell formation in group technology: Review evaluation and directions for future research. *Computers & Industrial Engineering*, *34*, 3–20.
Singh, N. (1993). Design of cellular manufacturing systems: An invited review. *European Journal of Operational Research*, *69*, 284–291.
Wu, T.-H., Chung, S.-H., & Chang, C.-C. (2009). Hybrid simulated annealing algorithm with mutation operator to the cell formation problem with alternative process routings, *Expert Systems with Applications*, *36*(2), 3652–3661.
Yin, Y., & Yasuda, K. (2006). Similarity coefficient methods applied to the cell formation problem: A taxonomy and review. *International Journal of Production Economics*, *101*, 329–352.
Yin, Y., Yasuda, K., & Hu, L. (2005). Formation of manufacturing cells based on material flows. *International Journal of Advanced Manufacturing Technology*, *27*, 159–165.

APPLICATION OF MODERN CONTROL THEORY TO INVENTORY CONTROL IN PHARMACEUTICAL DISTRIBUTION COMPANY

Lena Đorđević *[1], Slobodan Antić [1]
[1]Faculty of Organizational Sciences, University of Belgrade
*Corresponding author, e-mail: lena.djordjevic@fon.bg.ac.rs

Abstract: *Modern Control Theory (MCT) is an interdisciplinary area, which combines different mathematical concepts and methods in order to produce body of applied mathematics. This paper presents MCT as efficient tool for inventory control in pharmaceutical distribution companies. Inventory system of the pharmaceutical distribution company, which is considered as an example in this paper, has continuously changing state of sales. States of inventories are registered at the ends of the defined time period. Considered time horizon is one year. Structure of inventory system is generally known and represents sales forecast per months. The system was modelled based on the feedback control systems methodology. During the model creation, all elements of a feedback loop (reference, system, sensor, comparator, and controller) are created. When one or more output variables of a system have to follow a certain reference over time, a controller manipulates the inputs to a system in goal of obtaining the desired effect on the output of the system. Inventory control problem, modelled in accordance with MCT concept, is developed in spreadsheet. Spreadsheet is used for creation of decision making model. The results obtained from the model are used for procurement planning for more than 50 products per country, for five countries from East-Central Europe in year 2016.*

Keywords*: control theory, feedback loop, inventory control, pharmaceutical company, decision making model, spreadsheet*

1. INTRODUCTION

Pharmaceutical is one of the most sensitive and major industry that deals with human life. Quality and security are the most important to maintain. Inventory management of the industry is a difficult job. A pharmaceutical companies handle 500-600 types of products that includes huge amount of raw materials movement, packaging, secondary packaging of the finished products and delivering to the customers. Planning and scheduling in the pharmaceutical companies is a critical activity.

The primary distribution management goal is to maintain a steady supply of pharmaceuticals and supplies to facilities where they are needed, while costs of distribution should be the lowest. Distribution costs include costs related to storage, transport, customs and analysis etc. Designing a system for storing and distributing pharmaceuticals and medical supplies is complex and important.

Effective pharmaceutical distribution relies on good system design and good management. A well designed and well managed distribution system should (Managing distribution, 2012):

- Maintain a constant supply of medicines;
- Keep medicines in good condition throughout the distribution process;
- Minimize medicine losses caused by spoilage and expiry;
- Rationalize pharmaceutical storage points;
- Use available transport resources as efficiently as possible;
- Reduce theft and fraud;
- Provide information for forecasting medication needs;
- Incorporate a quality assurance program.

Centralized distribution is one option for pharmaceutical producer companies. Some countries procure and distribute medicines regionally, and some use commercial supply systems, which often exist in parallel with public systems. Collaboration between private and public systems may occur at any level. Private distribution companies can provide cost-effective alternatives for the storage and distribution of medicines, especially at the national and regional levels.

This paper presents simulation model, created to analyze the pharmaceutical distribution process and to determine ordering periods, in private pharmaceutical distribution company from Serbia. Model is aimed to

help the pharmaceutical distribution company to determine the reorder point for products and to reduce wastage in time and money. Model is designed based on MCT concepts.

2. MODERN CONTROL THEORY

The modern control theory is a discipline dealing with formal foundations of the analysis and design of computer control and management systems. Its basic scope contains problems and methods of control algorithms design, where the control algorithms are understood as formal prescriptions (formulas, procedures, programs) for the determination of control decisions, which may be executed by technical devices able to the information processing and decision making. The problems and methods of the control theory are common for different executors of the control algorithms. The control theory deals with the foundations, methods and decision making algorithms needed for developing computer programs in such systems. The problems and methods of the control theory are common not only for different executors of the control algorithms but also, which is perhaps more important, for various applications. In the first period, the control theory has been developing mainly for the automatic control of technical processes and devices. This area of applications is still important and developing, and the development of the information technology has created new possibilities and on the other hand new problems. The full automatization of the control contains also the automatization of manipulation operations, the control of executing mechanisms, intelligent tools and robots which may be objects of the external control and should contain inner controlling devices and systems. Taking into account the needs connected with the control of various technical processes, with the management of projects and complex plants as well as with the control and management of computer systems has led to forming foundations of modern control science dealing in a uniform and systematic way with problems concerning the different applications mentioned here. The scope of this area significantly exceeds the framework of so called traditional (or classical) control theory. The needs and applications mentioned above determine also new directions and perspectives of the future development of the modern control theory (Bubnicki, 2002).

Summarizing the above remarks one can say that the control theory (or wider − control science) is a basic discipline for the automatic control and robotics and one of basic disciplines for the information technology and management. It provides the methods necessary to a rational design and effective use of computer tools in the decision support systems and in particular, in the largest class of such systems, namely in control and management systems (Bubnicki, 2002).

The process of designing a control system generally involves many steps. A typical scenario can be presented as follows (Antic et al. 2012):

- Study the system to be controlled and decide what types of sensors and actuators will be used and where they will be placed;
- Model the resulting system to be controlled;
- Simplify the model if necessary so that it is tractable;
- Analyze the resulting model and determine its properties;
- Decide on performance specifications;
- Decide on the type of controller to be used;
- Design a controller to meet the specs, if possible. if not, modify the specs or generalize the type of controller sought;
- Simulate the resulting controlled system, either on a computer or in a pilot plant;
- Repeat from the first step, if necessary;
- Choose hardware and software and implement the controller;
- Tune the controller on-line, if necessary.

Control systems are most often based on the principle of feedback, whereby the signal to be controlled is compared to a desired reference signal and the discrepancy used to compute corrective control action, (Doyle et al. *1990).* The most elementary feedback control system has three components (Figure 1):

- a system (the object to be controlled, no matter what it is, is always called the system or plant),
- a sensor to measure the output of the plant, and
- a controller to generate the plant's input.

External input of a system is called the reference. When one or more output variables of a system need to follow a certain reference over time, a controller manipulates the inputs to a system to obtain the desired effect on the output of the system. The usual objective of control theory is to calculate solutions for the proper corrective action from the controller that result in system stability, that is, the system will hold the set point and not oscillate around it. The concept of the feedback loop to control the dynamic behaviour of the

system: this is negative feedback, because the sensed value by sensor is subtracted from the desired value to create the error signal, which is amplified by the controller (Doyle et al. 1990).

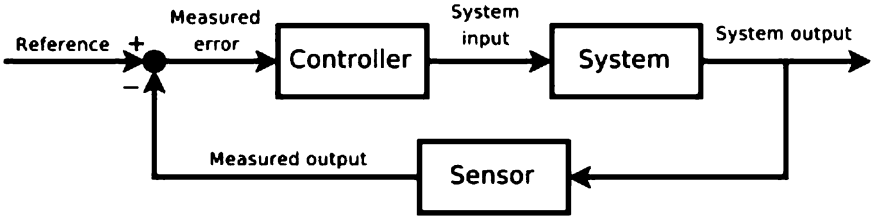


Figure 1: Concept of the feedback loop

Sensor can be define as device that converts a physical stimulus or input into a readable output, which today would preferably be electronic, but which can also be communicated via other means, such as visual and acoustic. As perhaps the simplest example, consider the sensor on keyboard switch actuator - which provides a signal when the associated key is pressed. The role of a sensor in a simple automation system is depicted in Figure 2. The detection and measurement of some physical effect provides information to the control system regarding a related property of the system under control, which we are interested in regulating to within some "set point" range. The controller outputs a command to an actuator (a valve, for example) to correct for measured deviations from the set point, and the control loop is thereby closed. Because of the simplicity of example in Figure 2 control system, it represents a fair number of practical control systems. In especially simple systems, a distinct controller may not be immediately evident (for example, thermostat), (Zook et al. 2008).

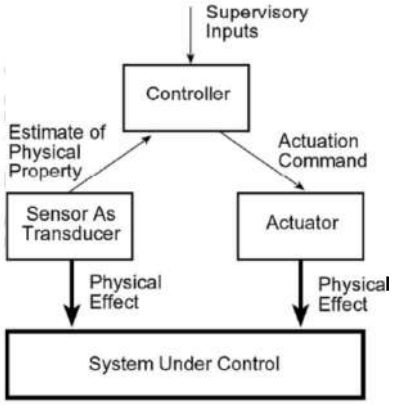


Figure 2: Example of a simple control system

A dynamical system is a system whose behaviour changes over time, often in response to external stimulation or forcing. The term feedback refers to a situation in which two or more dynamical systems are connected together such that each system influences the other and their dynamics are thus strongly coupled. Simple causal reasoning about a feedback system is difficult because the first system influences the second and the second system influences the first, leading to a circular argument. This makes reasoning based on cause and effect tricky, and it is necessary to analyze whole systems. A consequence of this is that the behaviour of feedback systems is often counter intuitive, and it is therefore necessary to resort to formal methods to understand them. In Figure 3 (a) the output of system 1 is used as the input of system 2, and the output of system 2 becomes the input of system 1, creating a closed loop system. In Figure 3 (b) the interconnection between system 2 and system 1 is removed, and the system is said to be open loop. A system is said to be a closed loop system if the systems are interconnected in a cycle, as shown in Figure 2 (Åström & Murray, 2009).

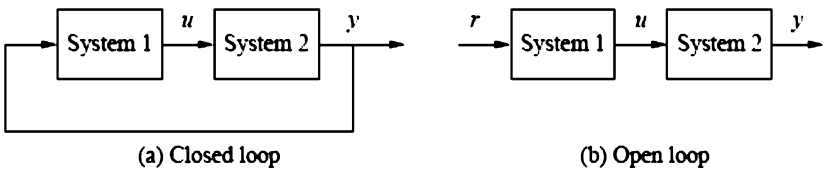


Figure 3: Open and closed loop systems

Feedback is an active concept in practically all area of activity. A feedback process is one in which the state of the system, or its output, determines the way in which the control has to be computed at any time instant (Neculai, 2005). Feedback has potential disadvantages as well. It can create dynamic instabilities in a system, causing oscillations or even runaway behaviour. Another drawback, especially in engineering systems, is that feedback can introduce unwanted sensor noise into the system, requiring careful filtering of signals. It is for these reasons that a substantial portion of the study of feedback systems is devoted to developing an understanding of dynamics and a mastery of techniques in dynamical systems. Feedback systems are ubiquitous in both natural and engineered systems. Control systems maintain the environment, lighting and power in our buildings and factories; they regulate the operation of our cars, consumer electronics and manufacturing processes; they enable our transportation and communications systems; and they are critical elements in our military and space systems. For the most part, they are hidden from view, buried within the code of embedded microprocessors, executing their functions accurately and reliably. The term control has many meanings and often varies between communities. We define control to be the use of algorithms and feedback in engineered systems. For example, the thermostat, in particular, is a simple example of feedback control that everyone is familiar with. The device measures the temperature in a building, compares that temperature to a desired set point and uses the feedback error between the two to operate the heating plant, e.g., to turn heat on when the temperature is too low and to turn it off when the temperature is too high (Åström & Murray, 2009). Another representation of feedback loops is optimal control and estimation in feedback loops.

3. INVENTORY CONTROL MODEL FOR PHARMACEUTICAL DISTRIBUTION

Pharma 4U gmbh is Swiss company, established in 2013. Main activity of this company is production and sale of innovative pharmaceutical products. 4U Pharma d.o.o. (http://4youpharma.com) is a branch in Serbia, aimed at pharmaceutical distribution for Balkan and neighbourhood countries. This company supplies wholesalers and pharmacies from Serbia, Macedonia, Montenegro, Bosnia and Herzegovina, Slovenia, Croatia, Albania, Rumania and Bulgaria. The company is constantly expanding, thanks to constant investment in development and monitoring of recent trends in the global pharmaceutical market.

Inventory management is an especially important for 4U Pharma d.o.o., as it is core activity of the company. At the end of every year company's logistics manager creates monthly sales forecast for next year. This forecast is based on historical data from previous years and manager's experience. At the beginning of every month customers from all countries deliver their stock reports. Ordering quantities and ordering periods are calculated in accordance with Fixed Order Quantity (FOQ), defined by supplier for each product (brand). There are more than one FOQ for each product and unit price depends on the ordered quantity. Order quantities are based on cumulative sales forecast for products of the same brand for different countries. Logistics manager orders articles of the same brand in total quantity for all countries, with remark about language for packaging and instruction. The company does not hold stocks and products are immediately transported to the clients, after customs and analysis. Production lead time is between 90 and 120 days, transportation lead time is up to 7 and custom and analysis 21 days. Total lead time, from order to delivery, is between 118 and 148. Additionally, manager negotiates about shortening of deadlines and price.

Ordering problem can be defined as follows: it is necessary to determine order quantities and ordering periods for each product (brand) for all countries, in accordance with FOQ, in order to provide enough inventories to cover monthly sales forecast, and to minimize distribution costs. Inventory management system is modelled in order to solve this problem. The system is modelled based on the feedback control methodology. During the model creation, all elements of a feedback loop are created (Figure 4).

Model is implemented in spreadsheet and procedures are automated through Visual Basic for Application (VBA). Spreadsheets are inexpensive and run on machines of modest specification. Due to ease of learning, usage and a great possibility for complex analyzing, spreadsheets have been accepted by many users at all levels, from beginners to experts (Lawson et al. 2009). Spreadsheets can be effectively used for analyzing logistics and supply chains issues. Usage of spreadsheets as logistics decision making software tool has exploded in the last two decades, driven by the need to optimize and integrate the supply chain. These tools are extremely effective in determining the optimum number of distribution locations, the appropriate mix of transportation modes, production scheduling, inventory optimization, product rationalization and strategic planning exercises (Smith, 2003). Spreadsheet software, notably Microsoft Excel, allows analysis from many different perspectives and can be modified and enhanced to reflect new situations and options. Moulder develops a baseline model according to current operations, creates alternative scenarios and compares those scenarios to the baseline. Non-quantifiable factors and soft costs are also considered to develop a complete analysis. Using spreadsheet, moulder can analyze the impact of business decisions on any

number of variables, such as: logistics strategies, flow planning, inventory control, allocation and aggregate planning and network design and planning. Also, spreadsheet charts and graphs are excellent tools to provide visual impact to the logistics problems analysis. The effective use of graphs can aid in understanding the models' results. Contrary to the traditional logistics software, that may not always provide the flexibility required, spreadsheet allow analysis from many different perspectives and can be continually modified and enhanced, to reflect new situations and options. The user can add complexity to the model, in compliance with the increase of experience and knowledge about the process. Spreadsheet models can be used for strategic, operations or logistics planning and in many cases can be used simultaneously for all cases (Djordjevic & Vasiljevic, 2013).

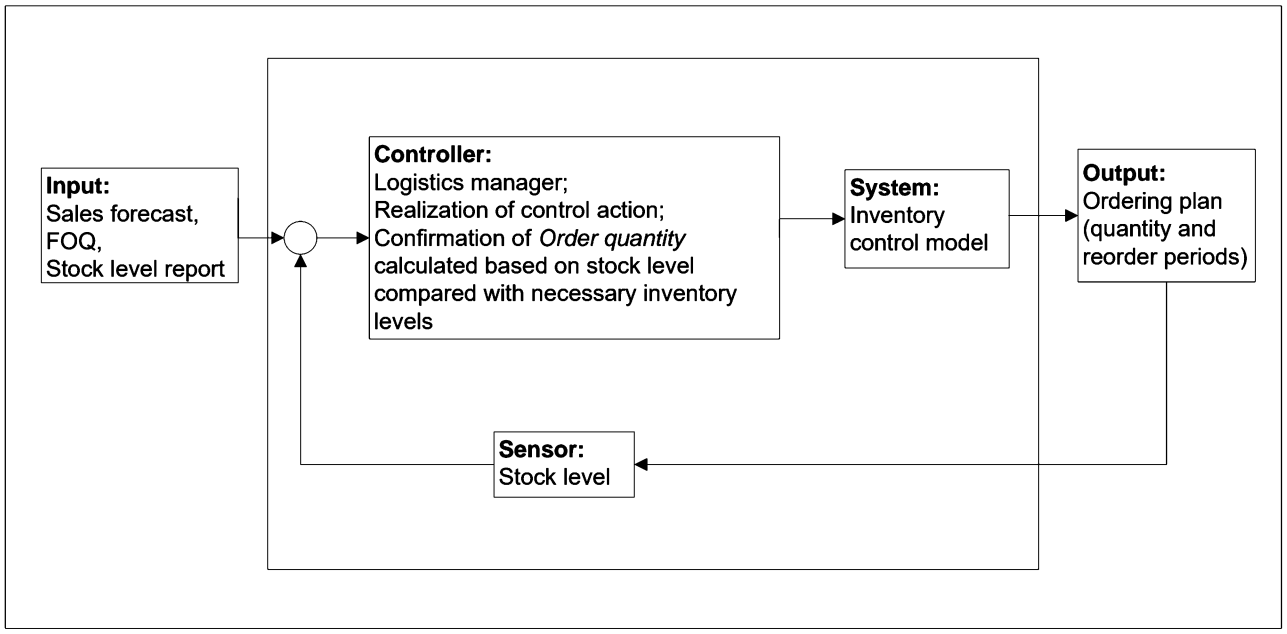


Figure 4: Elements of a feedback loop for inventory control model

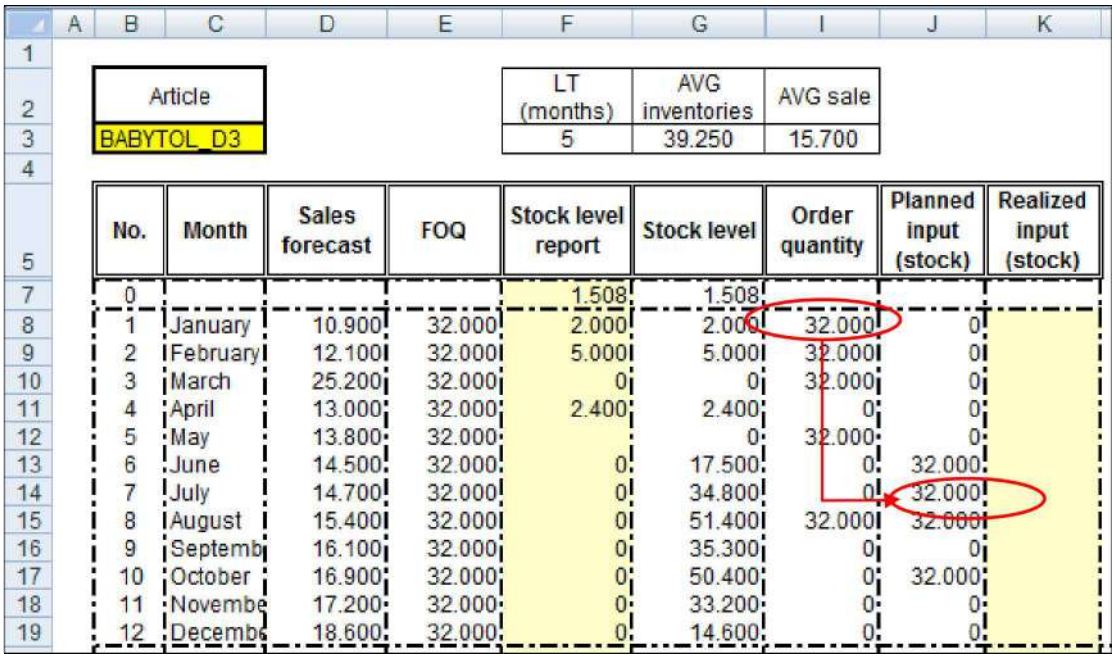
Input elements for feedback control systems model are sales forecast, FOQ and stock level report (Figure 5). Monthly sales forecast is created at the beginning of year for entire next year, based on historical data from previous years and manager's experience. FOQ is defined by supplier. There are more than one FOQ for each product and unit price depends on the ordered quantity. At the beginning of every month, each wholesaler and pharmacy (customers from all countries) sends a report about stock level status to 4U Pharma's logistics manager. This report is prescribed form and format in Excel spreadsheet.

No.	Month	Sales forecast	FOQ	Stock level report	Stock level
0				1.508	1.508
1	January	10.900	32.000	2.000	2.000
2	February	12.100	32.000	5.000	5.000
3	March	25.200	32.000	0	0
4	April	13.000	32.000	2.400	2.400
5	May	13.800	32.000	1.200	1.200
6	June	14.500	32.000	0	18.700
7	July	14.700	32.000	0	36.000
8	August	15.400	32.000	0	52.600
9	Septemb	16.100	32.000	0	36.500
10	October	16.900	32.000	0	51.600
11	Novembe	17.200	32.000	0	34.400
12	Decemb	18.600	32.000	0	15.800

Figure 5: Input elements of inventory control model

In addition, monthly stock level has to be calculated. As stock level report is received at the beginning of month, it corresponds to the level at the end of previous month. Stock level for current month is calculated as

sum of stock level quantity at the end of previous month and planned input and reduced for forecasted sale. In that way model covers whole year, even future months, where stock level is calculated based on planned delivery (input) and forecasted sale (output). Column *Stock level* (Figure 5) represents stock levels for all months in observation period at one place, which are calculated in described way. In this way, we define the sensor function of model, which prepares data for comparison in the model comparator.



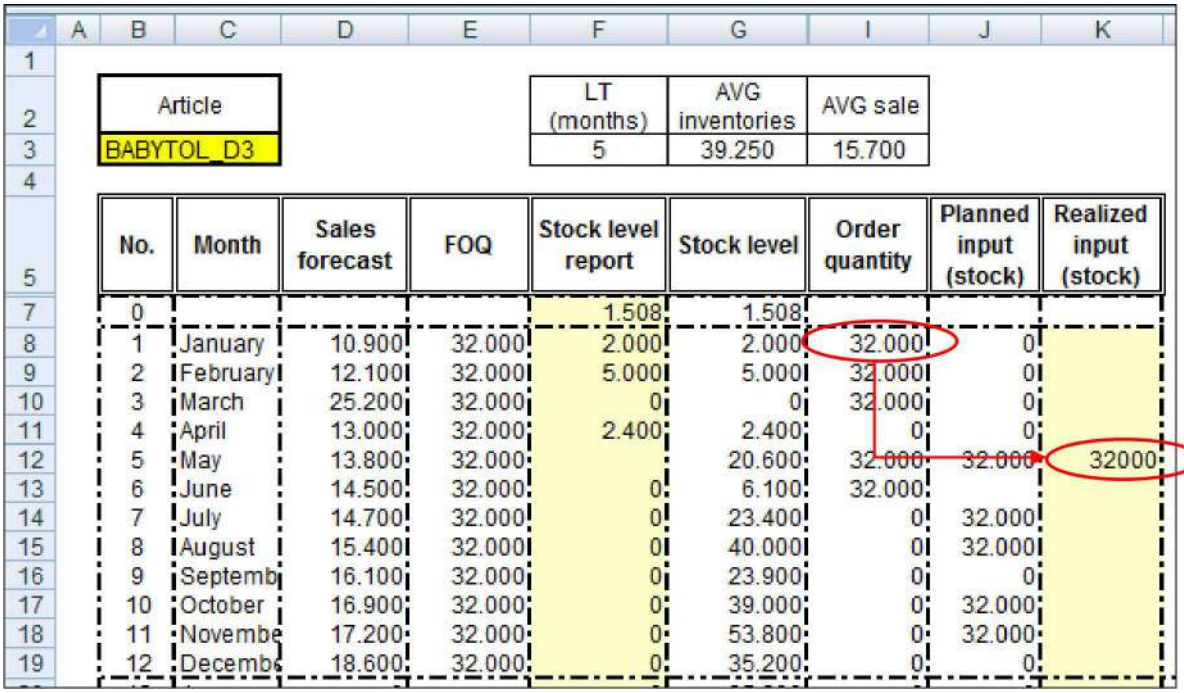
Article
BABYTOL_D3

LT (months)	AVG inventories	AVG sale
5	39.250	15.700

No.	Month	Sales forecast	FOQ	Stock level report	Stock level	Order quantity	Planned input (stock)	Realized input (stock)
0				1.508	1.508			
1	January	10.900	32.000	2.000	2.000	32.000	0	
2	February	12.100	32.000	5.000	5.000	32.000	0	
3	March	25.200	32.000	0	0	32.000	0	
4	April	13.000	32.000	2.400	2.400	0	0	
5	May	13.800	32.000		0	32.000	0	
6	June	14.500	32.000	0	17.500	0	32.000	
7	July	14.700	32.000	0	34.800	0	32.000	
8	August	15.400	32.000	0	51.400	32.000	32.000	
9	Septemb	16.100	32.000	0	35.300	0	0	
10	October	16.900	32.000	0	50.400	0	32.000	
11	Novembe	17.200	32.000	0	33.200	0	0	
12	Decembe	18.600	32.000	0	14.600	0	0	

Figure 6: Spreadsheet inventory control model

Unusually long lead time (LT) indicates that order quantity has to be calculated based on inventory levels and sales forecast for all months between current period (t) and delivery period (t+LT). Comparator is used to determine the difference between necessary inventory levels for observed months and actual state of stock. Defined differences in the output of comparator are used for making final decisions about quantities of items that will be ordered and delivered to each wholesaler and pharmacy and time periods when orderings have to be realized (reorder periods). According to comparison algorithm (Figure 8), stock levels are compared with necessary inventory levels. Necessary inventory levels consider that demand should always be satisfied. Based on these differences, order quantity and reorder periods are calculated and presented in column *Order quantity* (Figure 6), which now realizes function of the model controller.



Article
BABYTOL_D3

LT (months)	AVG inventories	AVG sale
5	39.250	15.700

No.	Month	Sales forecast	FOQ	Stock level report	Stock level	Order quantity	Planned input (stock)	Realized input (stock)
0				1.508	1.508			
1	January	10.900	32.000	2.000	2.000	32.000	0	
2	February	12.100	32.000	5.000	5.000	32.000	0	
3	March	25.200	32.000	0	0	32.000	0	
4	April	13.000	32.000	2.400	2.400	0	0	
5	May	13.800	32.000		20.600	32.000	32.000	32000
6	June	14.500	32.000	0	6.100	32.000		
7	July	14.700	32.000	0	23.400	0	32.000	
8	August	15.400	32.000	0	40.000	0	32.000	
9	Septemb	16.100	32.000	0	23.900	0	0	
10	October	16.900	32.000	0	39.000	0	32.000	
11	Novembe	17.200	32.000	0	53.800	0	32.000	
12	Decembe	18.600	32.000	0	35.200	0	0	

Figure 7: Input realized earlier then it is planned

Column *Realized input* is used in cases when order arrives earlier or later than expected. In those cases, whole model is recalculated automatically. For example, if ordering is realized in January and LT=5 months, then ordered quantity is delivered after five months, in June (Figure 6). However, if delivery of articles ordered in January is realized earlier, in May, then stock level is increased and ordering plan has to be changed (Figure 7), in accordance with comparison algorithm (Figure 8).

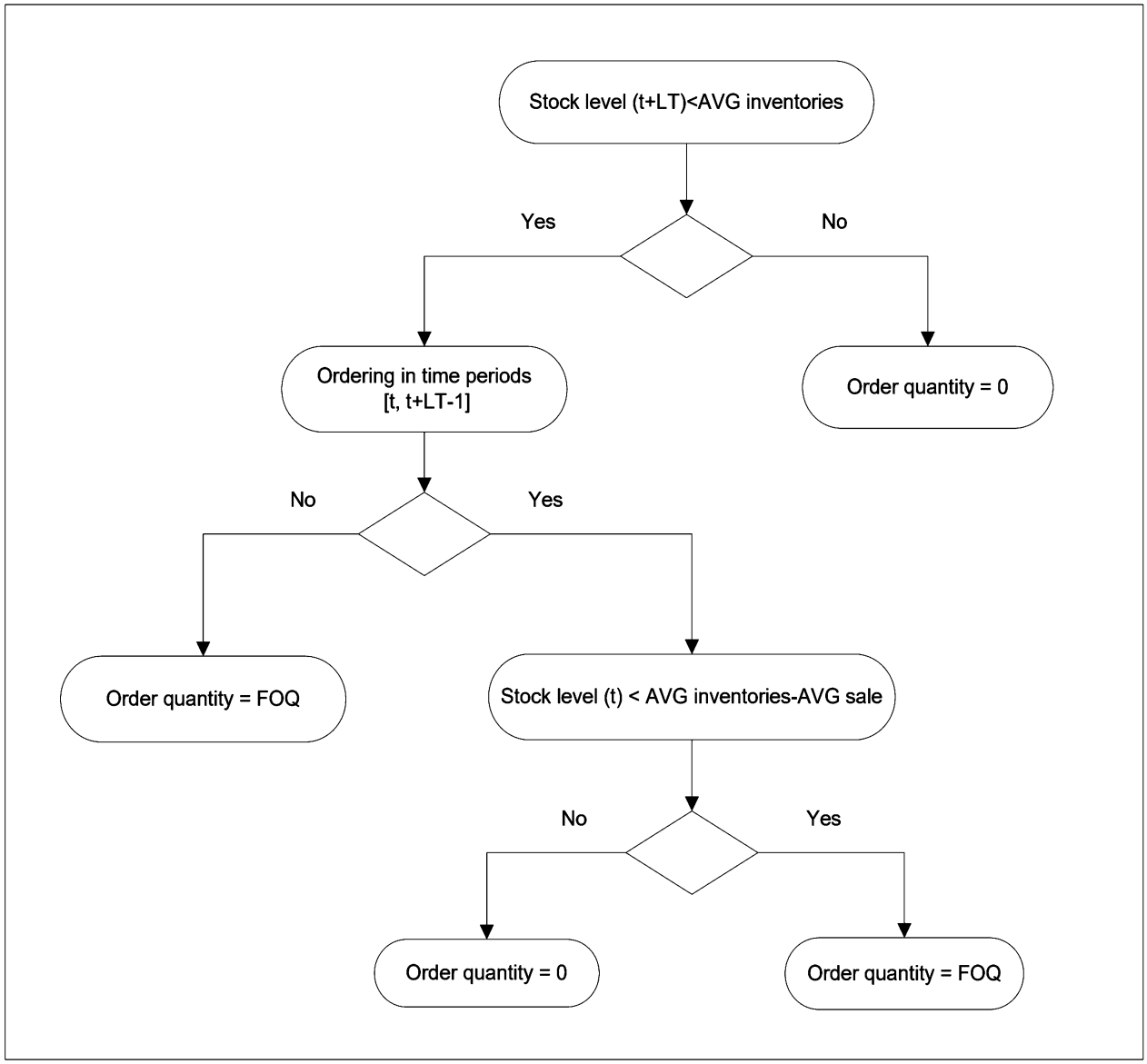


Figure 8: *Comparison algorithm

Model controller function is realized in position of logistics manager. His control role is to confirm order quantity for each product and if it is necessary to make a change of order, in accordance with FOQ, in order to get a lower price. Manager compares and control calculated order quantities in compliance with stocks level, prices, sale forecast, etc.

When quantities are approved, order is realized and sent to production, to 4U pharma gmbh. These actions as an effect has inventories planned level filling for all clients, wholesalers and pharmacies from different countries. Additionally, when order quantity and delivery is confirmed from production plant, whole quantity (FOQ) is assigned to the countries and clients (Figure 9). In this manner, logistics manager controls distribution of ordered quantity, which provides articles necessary for customer requirements fulfilment.

* AVG inventories - average inventories = (AVG sale * LT)/2 AVG sale - average sale for one year

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1														
2			2016											
3			Januar	Februar	Mart	April	Maj	Jun	Jul	Avgust	Septembar	Oktobar	Novembar	Decembar
4		BABYTOL_D3	0	0	0	0	0	0	0	32.000	32.000	32.000	0	32.000
5		BB01BLSRB01					18000	20000						
6		BB01BLMKD01					13000	8000						
7		BB01BLENG01					1000	4000						
8		BABYTOL_D3_K1	0	0	0	0	0	0	32.000	0	0	32.000	0	0
9		BB01BLSRB02						20000						
10		BB01BLMKD02						6000						
11		BB01BLENG02						6000						
12		PROBIO_CHOCO	0	0	0	0	0	0	0	0	0	0	0	0
13		PB01BLSRB01												
14		PB01BLMKD01												
15		PROBIOChoco_C_Zn	0	0	0	0	0	0	32.000	32.000	0	32.000	0	32.000
16		PB01BLSRB02						12000						

Figure 9: FOQ quantity assignment

4. CONCLUSION

Many professionals, as well as beginners, from different fields make important decisions based on spreadsheet analysis, and organizations rely on them in record keeping, forecasting, analysing, decision making etc. Spreadsheets are an indispensable tool for simple, quick and easy processing and data analysis for activities of planning, modelling and control of inventories. Apart from logistics, spreadsheet models have a great importance in many other disciplines and fields such as finance, quality management, human resources, quantitative methods and etc. Spreadsheet modelling can be very simple or very complicated and prone to errors and consequently cause of bed decisions, in dependency of how much is moulder familiar with model developing methodology and data organizing in control models. Modern control theory and feedback control system provide basic concepts and elements that can be used for model creation.

Management of pharmaceutical inventory and pharmaceutical distribution have become a major challenge for pharmaceutical companies, as they simultaneously try to reduce costs and improve customer service level in an increasingly competitive business environment. Implementation of modern control theory and feedback control system logic can make inventory control of pharmaceutical articles easy and effective.

Focal point of this paper is inventory control in pharmaceutical distribution company, with an emphasis on order quantities and reorder periods, which have to satisfied specific constraints, described in the paper. As it is presented, inventory control system with feedback is implemented in spreadsheet. This spreadsheet model allows analysis from many different perspectives and can be modified and enhanced to reflect new situations and options. We have developed baseline model that enables alternative scenarios creation and compares those scenarios to the baseline. The results obtained from the model are used for procurement planning for more than 50 products per country for several countries from East-Central Europe for the year 2016.

REFERENCES

Antic, S., Kostic, K. & Djordjevic, L. (2012, June). Spreadsheet model of inventory control based on modern control theory. Paper presented at the *XIII International Symposium SymOrg 2012: Innovative management and business performance.*

Åström, K., & Murray, R. M. (2009). *Feedback systems: an introduction for scientists and engineers*. Princeton University, New Jersey: Princeton University Press.

Bubnicki, Z. (2002). *Modern Control Theory*. New York: Springer Berlin Heidelberg

Doyle, J., Francis, B., & Tannenbaum, A. (1990). *Feedback Control Theory.* UK: Macmillan Publishing Co.

Djordjevic, L., & Vasiljevic, D. (2013, March). Spreadsheets in education of logistics managers at Faculty of Organizational Sciences: An example of inventory dynamics simulation. Paper presented at the *8th International Technology, Education and Development Conference, INTED2013.*

Lawson, B. R., Baker, K. R., Powell, S. G. & Foster-Johnson, L. (2009). A comparison of spreadsheet users with different levels of experience. *Omega, 37*(3), 579-590.

Managing distribution (2012). Management Sciences for Health. Retrieved 12, April 2016, from http://www.msh.org/

Neculai, A. (2005). *Modern Control Theory-A historical perspective*. Romania: Research Institute for Informatics, Center for Advanced Modeling and Optimization.

Smith, G. A. (2003). Using integrated spreadsheet modeling for supply chain analysis. *Supply Chain Management: An International Journal, 8*(4), 285-290.

Zook, D., Bonne, U., & Samad, T. (2008). Sensors in control systems. In *Control systems, robotics, and automation.* USA: Encyclopedia of life support systems.

4U pharma | swiss quality. (2016). *4youpharma.com*. Retrieved 12, April 2016, from http://4youpharma.com/

STATIC CODE ANALYSIS AND REPORTS BASED APPROACHES FOR SPREADSHEET ERRORS DETECTION

Miloš Živić*[1], Lena Đorđević[1], Danica Lečić-Cvetković[1]
[1]Faculty of Organizational Sciences, University of Belgrade
*Corresponding author, e-mail: mzlosmi@gmail.com

Abstract: *Spreadsheet programs represent one of the most successful end-user software development tools, used for a variety of purposes. Professionals from different fields make important decisions based on spreadsheet models, simulation, analysis and organizations rely on them in record keeping, forecasting, analysing, planning etc., although, the statistics say that there are many errors in spreadsheets. Considering that the quality of business decision makes difference between success and failure, one must be sure that a spreadsheet doesn't contain an error that could get the decision maker to think of a problem in a wrong way. Consequently, spreadsheet risk awareness has been significantly increased over the last two decades and researchers have proposed a number of approaches, techniques and automated tools aimed at supporting end-users in error detection and debugging. In this paper focal points are spreadsheet error detection approaches from category static code analysis and reports. Four different approaches are presented and the gap that enables existing errors not to be found is discovered, which leaves space for future research in order to narrow the gap, especially in database manipulation field. Some of the approaches mentioned are concerned with units and types of the data, some are dealing with dimensions of the data and some of them are dealing with both. Since most of them are very specialized, not any of them can be marked as the best, since each one of them is used in a special area. Correspondingly, the goal of this paper is to recognize positive aspects of existing approaches and combine them into universal method applicable on more groups of error detection problems.*

Keywords*: spreadsheet errors, error detection, static code analysis, reports*

1. INTRODUCTION

Spreadsheet applications represent the most successful example of developing applications by the end user. The great advantage of spreadsheets is that they allow professionals from non-programming areas to create their own tools to support their business and to apply their domain expertise. The tools developed in this way are often available very soon, unlike many other applications used in business and that have to be developed by special IT departments. However, even if spreadsheets have many advantages as an environment that provides fast development of business applications, it leaves a lot of space for errors. Some more recent papers about spreadsheet errors, like the one by Jannach, Schmitz, Hofer and Wotawa (2014), show that there was at least one error found in every single spreadsheet they have tested. Sometimes, these errors don't affect the business, and on the other hand, there are spreadsheets used for decision making in very important situations, so every error of any type could make a difference between survival and disaster of a company, or even greater consequences.

A feature of developing their own tools that was given to end users has certain advantages, like flexibility, independence, development speed, lower risk of communication problems. But, there are also some flaws, and the greatest of all of them is possibility to create spreadsheet tools with errors, as described by Luckey, Erwig and Engels (2012) and Cunha, Erwig and Saraiva (2010). As the total number of spreadsheet users is a lot greater than the number of programmers, and as their needs for applications are great, the number of spreadsheet applications created every day is very great too. However, end users are not trained enough to check their applications for errors and that causes development and usage of their applications even on real data, even if they have errors. In order to minimize risks, spreadsheet experts have developed various approaches for avoiding, detecting and correcting errors in spreadsheets. It is possible to lower the risk by investing into education and training of end users, then, by creating organizational procedures for evaluation and development of spreadsheet applications, and, finally, by developing support to end users that will help them to identify errors while creating the spreadsheet tool (Jannach et al., 2014).

This paper highlights static code analysis and reports. The main goal of this paper is to present available solutions for analysis and to reveal the gap for further research and development of an approach that would

enable, if not eliminating, then at least narrowing the gap between the errors that occur and the ones that can be found by using some of existing methods.

2. TYPES OF SPREADSHEET ERRORS

Errors in spreadsheets can be classified based on various criteria. Differing error types is important because each error type demands another method for detection. Errors can be divided into two main groups: qualitative and quantitative. Quantitative errors most often come as a result of a numerical error that could lead to wrong end results. On the other side, qualitative errors occur because of wrong spreadsheet design, for example double entries or few entries in one cell.

According to Teo and Tan (1999), quantitative errors can be mechanical, logical and omission errors. Mechanical errors are those that occur because of simple things like wrong number entry, watching the wrong cell address or selection of the wrong area of cells. The main reason why users make these mistakes is lack of attention, stress, work overload or bad work environment. Logical mistakes are more complex and they occur because of wrong formula. Wrong formula comes as a result of wrong algorithms caused by the lack of domain expertise. For example, it is possible to determine price only by adding variable costs, while forgetting about fixed ones. The consequence is very clear, the product might be sold at a price that doesn't cover total costs for its production. For detecting spreadsheet errors it is required to have more experience than for detecting mechanical errors because it requires, except knowing spreadsheet technique well, also knowing the business process. Finally, there are omission errors. They are caused by not including some important element in the model. As with logical errors, they are not easy to find and it requires both, knowing the spreadsheet techniques well, but also understanding the business processes.

On the other side, according to Rajalingham, Chadwick and Knight (2008), spreadsheet errors can be divided into few groups. System generated errors are those generated by spreadsheet tool or a bug in software. Their creation is above users' control, but, if users are aware of them, they can perform steps to avoid them. Errors generated by end users can be prevented, detected and corrected. They can be qualitative and quantitative. Quantitative errors can be accidental, as errors and omissions created by lack of attention, like typing errors. They can be caused by spreadsheet designers or end users. Designer could select a wrong field, double some entry or create an omission error. When it comes to end user, they can be divided into two groups: those who enter the data and those who read the data. Both groups can create errors of the same type as the developer. The second type of quantitative errors is a reasoning error that could be an error caused by not knowing the domain enough, like not understanding the business process or mathematical way of displaying. Quantitative errors include errors during implementation process, that can be syntax and logical errors. The other group of spreadsheet errors is qualitative errors. They can be semantic and errors for future maintenance. Semantic errors are those with wrong structure and time – entering data that is not up-to-date, while maintenance errors are those that make data entry more difficult, but also other types of upgrades.

3. CATEGORIES OF APPROACHES FOR SPREADSHEET ERRORS DETECTION

For identifying errors in spreadsheets, many approaches and tools were primarily developed and used for the same cause in software engineering. However, as it was mentioned above, the feature of spreadsheet error detection is in immediately visible results, the user gets visual feedback as a result of applying function on some data. Spreadsheets are different than common program languages because all the calculus is done within the cells that contain formula and they are performed with data contained in other cells. Also, in spreadsheet, every datum has its physical position, but also its semantic of calculus. Potential errors can be found based on sign in data header that puts every single datum into some context and then it is possible to make conclusions about characteristics of results of certain formula.

The technology of spreadsheets enables users who come from different areas and levels of spreadsheet knowledge to create their own models. Most of the users don't know even the basics of spreadsheet model quality assurance. Because of that, this process has to be done in a way that requires minimal or no end-user participation in a way that doesn't depend on the level of expertise of the user.

Approaches to software quality assurance (QA), applicable to spreadsheets, are categorized in two major groups (Đorđević and Lečić-Cvetković, 2015):

- Identifying and correcting errors – techniques and tools designed to help users to detect errors, identify its cause and suggest correction. These tools are used by spreadsheet creators, auditors and reviewers, during or after development of spreadsheet model.

- Avoiding errors – contains techniques and tools that support spreadsheet development without errors. They are applied during the spreadsheet model development process.

Finer-grained categorization of the existing approaches to automated spreadsheet quality assurance can be seen in the Table 1.

Table 1: Automatic spreadsheet quality assurance approaches categorization (Đorđević and Lečić-Cvetković, 2015):

N°	Spreadsheet QA approaches	Identifying errors	Avoiding errors
1.	Visualization based	x	X
2.	Static code analysis and reports	x	X
3.	Testing	x	
4.	Automatic localization and correction	x	
5.	Model based development		X
6.	Design and maintenance support		X

Categories 1 and 2 can be used for identifying and avoiding errors. For example, good visualization of dependencies among cells helps users to identify the problem, but also to identify cells that have high chances of creating errors. Static code analysis discovers existing errors like a reference to an empty cell or listing formulas that are too complex. On the other side, 3 and 4 are used for identifying and localization of already made errors. Methods 5 and 6 are made for avoiding errors, for example, by refactoring or adding levels of abstraction.

4. STATIC CODE ANALYSIS AND REPORTS

Static code analysis is the spreadsheet QA area that has major usage options and can be divided into three subgroups: unit and type inference, spreadsheet "smells", static analysis and commercial tools, as it is explained by Đorđević and Lečić-Cvetković (2015). However, these approaches are often combined in order to discover more errors.

Static code analysis and reports based approaches analyze formula in spreadsheets and show potential errors or wrong spreadsheet design that could lead to future errors. This approach doesn't analyze cell values. The approach is based on formula and their dependencies, their static labels and other structural characteristics of the spreadsheet.

Unit and type inference is an approach that belongs to static code analysis and report based approaches, and the main idea of this method is getting information about cell units and using them in order to make a conclusion if the calculation makes sense or not. In order to get information about units, headers are used. Erwig and Burnett (2002), in their first papers from this field, were only telling about ways how to get information based on header, and later they developed procedures how to actually perform that without user efforts. The newer papers of these authors are directed to label analysis and attempts to get them down to known units and to decide on calculations based on that. Some of them require user to enter units, while the newest of them even have systems for unit recognition based on the label.

The group of spreadsheet "smells" methods is contained by methods that don't "say" that in some spreadsheet there is an error nor that there will definitely be some error in future. They are designed in a way to recognize spreadsheet parts where there is too much space for errors, because of spreadsheet design: long formula, too many references to another spreadsheet, constant values in a formula, etc.

Finally, techniques of static code analysis are often used as a part of commercial tools. Many of them can be seen in MS Excel in order to mark "suspicious" formula that maybe shouldn't be where they are, or they could be made in some other way, as it was presented by Jannach, Schmitz, Hofer and Wotawa (2014). In the next section of this paper, methods developed by spreadsheet engineering experts are presented, by highlighting virtues and flaws of their methods, in order to identify directions for future development.

5. STATIC CODE ANALYSIS AND REPORTS APPROACHES OVERVIEW

The basic principles of identifying errors in spreadsheets based on unit and type inference are presented in Erwig and Burnett (2002). This approach presents one of the basic methods for spreadsheet errors detection from static methods and is based on an idea of identifying errors related to forbidden combinations of units. The goal of this paper was to discover errors in system if they occur during entry, at the moment of data

entry. Errors are identified based on units, where unit is a label entered in table header. There is an acknowledgement of the existing need for functions of higher level, but it is limited only to first level functions. These functions are the ones that make a result some value that is in the unit of same level and it doesn't include option of using functions where a new dimension is created as a result of applying function on existing values. Because of the striving to achieve greatest functionality possible, the authors made four limitations set (Erwig and Burnett, 2002):

- The first one includes inference mechanism that provides immediate feedback of visual type in order to know if the formula is error-free.
- The second limitation is that inference system uses labels and functions that users use.
- The third limitation is related to formal unit labelling. An additional limitation is a mechanism of inference that does it function without need to predefine formal units.
- The fourth one defines a mechanism that is applied to real spreadsheets created by users and doesn't include assumption that users will use the right formula in a right way.

Headers are labels that assign units to a group of cells. A cell can have few headers. A header is explicit information about cells to which it belongs and based on its units are checked. Header can be defined by expected entry information, based on formatting and position in spreadsheet. Headers and cells can have different relations. Dependable units are present on few levels. For example, higher level unit – a car, can be a limousine, roadster, a sports-utility vehicle etc. Relations "and" and "or" refer if a cell can have one or both units. The logic of this model is based on defining well-formed units and differing them from those that are not.

Well-formed unit is 1, as an universal unit, then, unit that doesn't have a header. If a cell has value *v* and a header *z*, then, *z(v)* is a well-formed unit. One example includes "and" operations that combine values without common predecessors. Also, well-formed unit is a unit that comes as a result of "or" operation when two units have common predecessors. According to Erwig and Burnett (2002), rules for unit inference are:

- If a cell doesn't have header, the unit is 1;
- If cell a has header b that contains value v and has a well-formed unit u, then *u(v)* is a unit of a;
- If a cell has a reference to some other cell, it will also have the cell's unit;
- Each mathematical operation has its own definition of combining units.

In accordance with rules and limitations, an algorithm for unit inference was created, based on units and the operation that are used in formula. It is logical that adding and reducing are done over data of same units and that result has the same unit. The complete algorithm is based on an idea to get well-formed units from operations. If it is not possible, the system will report error.

Unlike the previously presented paper, Ahmad, Antoniu, Goldwater and Krishnamurthi (2003), based their paper on an idea that spreadsheets are made of cell locations, values and expressions. Header is a common unit for a group of cells. The presumption is that all headers are known. There are two types of relations "is-a" and "has-a". "Is-a" is used for belonging to a type, for example "apple is a fruit", and, "has-a" tells that header has some characteristic "apple has an attribute colour". Units are defined in the same way as in the previous model. In order to use the method, the authors have defined four rules for "calculating" units in the model (Ahmad, Antoniu, Goldwater and Krishnamurthi, 2003):

- The first rule is that each cell has one or zero "is-a" relations. If no, then it is "top" and the unit is the header label. Otherwise, it is a concatenation of header label and its cell label.
- The second rule says that cells that contain values and are not in header get units from their headers. Each cell containing user data must have at least one "is-a" header. Except that, there must be at least one "is-a" header with "has-a" relation. If there is only one "is-a" header, unit of a cell is formed by concatenating header unit and the header label to get "is-a" part and by adding existing attribute in the end. If there are few "is-a" headers, every "is-a" has its own hierarchy, and results are combined.
- The third rule explains that cells that contain only references are taking units of referenced cells.
- The fourth rule explains that cells that contain formula get unit based on rules of mathematical operation.

Adding is defined in situations when there is an "is-a" operation with common "has-a" relation, adding and reducing with common "is-a" with different "has-a" part. The defined didn't include the case when both "is-a" and "has-a" are different. Based on functioning of adding and reducing, it can be said that any binary operator calculates units correctly in two cases – common "is-a" part – result of the operation is combination of two different "has-a" parts, also defined for common "has-a" parts. The authors also defined the "&" operation. The spreadsheet has an error if it comes between two units with common header ("top" not included). Examples of these rules, according to Ahmad, Antoniu, Goldwater and Krishnamurthi (2003), are given below (the mark for "has-a" part is "{}", and for "is-a" part - "[]"):

$$Fruit[Apples]\{Quantity\}+Fruit[Oranges]\{Quantity\}=Fruit\{Quantity\}$$

In other words, adding quantities of apples and oranges results as a quantity of fruit.

$$Fruit[Apples]\{Costs\}+Fruit[Apples]\{Profit\}=Fruit[Apples]\{Costs\circ Profit\}$$

If costs of apples are added to their profit, there will be a new unit – result of operation ◦ on cost and profit. A situation not covered with this model can be presented as:

$$Fruit[Apples]\{Costs\}+Fruit[Oranges]\{Profit\}$$

This method also covers a case with multiple relations of subtype:

$$Fruit[Apples][Bad]+Fruit[Oranges][Bad]=Fruit[Bad]$$

"Bad" is a subtype, and not an attribute. The result of adding is "Bad Fruit". Reducing is defined in the example below:

$$Fruit[Apples[Total]]\{Quantity\}+Fruit[Apples[Bad]]\{Quantity\}=Fruit[Apples]\{Quantity\}$$

Reducing "bad apples" from total quantity will result with quantity of "good apples", but, it is impossible to conclude that unless it is predefined that only two subtypes of apples are "good" and "bad". The authors also defined the case with common subtype, but different attribute:

$$Fruit[Apples]\{Revenue\}-Fruit[Apples]\{Costs\}= Fruit[Apples]\{Revenue\circ Costs\}$$

The result is a common type-subtype part with an attribute received as a result of operation over two different attributes. In case of multiplication, a situation simplest described on shapes is defined:

$$Shape[Square]\{Width\}xShape[Square]\{Height\}=Shape[Square]\{Width\bullet Height\}$$

The result is a common subtype part, and it gets a combination of different attributes. The case of different subtypes and same attributes is not defined, but, the system won't report error in this case. The concatenation operation, often used in spreadsheets can be used only for elements with headers that are not common and at most one of them has an attribute.

A different approach is given by Chambers and Erwig (2009), where error identification is performed on three levels:

- headers;
- labels that simplify units and search for already known units and inferring based on it;
- inference on dimensions, by checking all the cells with formula and getting final dimensions by rules described in the paper.

The authors defined dimensions for many operations that can be performed in spreadsheets: adding, multiplication, "if" function, count, reference and "regular" cell's dimensions (Figure 1).

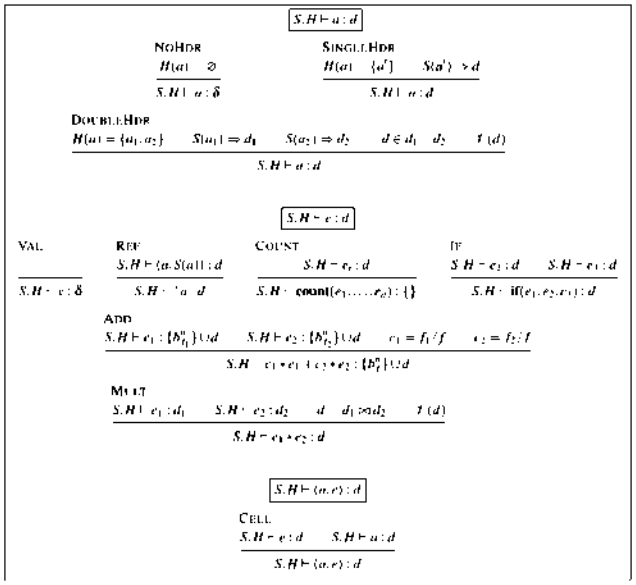


Figure 1: Inference rules (Chambers and Erwig, 2009)

In case that the dimension cannot be defined, the system reports an error. Also, exponents of existing dimensions are included. The logic of the approach on the example is presented in Figure 2.

F5 =B5+MAX(F2*60-C5,0)*D5

	A	B	C	D	E	F	G
1							
2				Hours of use	15	25	35
3							
4	Plan	Base Fee	Plan Minutes	Usage Charge	Total		
5	Verizon	39	1000	0.025	39.00	51.50	66.50
6	Quest	49	1500	0.021	49.00	49.00	61.60
7	Xingular	29	500	0.026	39.40	55.00	70.60
8	IBN	0	0	0.034	30.60	51.00	71.40

Figure 1: Example of the approach used on spreadsheet (Chambers and Erwig, 2010)

In the Figure 2, cell F5 contains a formula "=B5+MAX(F2*60-C5,0)*D5". Authors applied the rule given in the Figure 1, labelled "CELL". The value has dimension based on formula it contains and its header. Header "Total" can represent a sum of different units, however, since these spreadsheets are from finance area, the guess is that it is $. The conclusion is that F5 should have $ unit, but it is not confirmed that the result of the formula will be in $. Because of that, addition rule is applied, but after the reference rule. Based on that, B5 part has dimension $, like in original formula.

The other part of formula uses rule for unit inference in multiplication. Field D5 doesn't have a unit, and dimension of second factor is received from addition rule and it can be also applied to "max" function. If the operation is watched, it is clear that it has few parts. In F2, there are hours, and, it is logical that multiplied by 60, the result is in minutes. Then, it is reduced by minutes. Then, by the rule of multiplication, in order to get $, it must be in $/min, so it can be said that D5 has $/min unit, which is acceptable, if the logic of the model is had in mind. Finally, adding of two values in $ will result in $. In this case, no errors are reported.

Another example for showing functionality that is not contained by previous example, is an example of adding values that have common basic unit, but their factors are different (centimetres and meters). Centimetres require multiplication with 0.01, so the system will report error, but it will be able to suggest a correction.

In a paper about identifying errors, Chambers and Erwig (2010) use a combination of mentioned methods, for example, there is an approach of integration of dimension and unit inference. First, header inference, then, understanding labels, identifying dimensions and label axis, then, combined inference based on labels and dimensions. Header inference analyzes structure of spreadsheet and returns a set of headers for each cell. Header represents an address of other cell. One cell can be a header for many cells, and any cell can have zero, one or more headers. In this paper, headers can be vertical and horizontal. Header inference is

performed by analyzing spatial relations between the formulas. Label inference relates to a situation when dimensions are derived based on its header's label. Labels are separated into words that are translated into dimensions and then all of them are combined into one dimension.

When identifying labels and dimensions, there are three different cases (Chambers and Erwig, 2010):

- no dimensions,
- one dimension and
- two dimensions.

In the first case, only labels are watched. The second case represents a combination of label and dimension inference. An axis is determined for each dimension and label. A cell has a combination of characteristics received as a result of separate use of mentioned methods. The third case is the same, but for both of them, dimension inference is used.

The combination of labels and dimensions inference has many levels: value inference, header inference, expression inference and cell inference. The advantage is that it checks only if units are the same. This is easier because dimensions are combined into one, so it is easier to determine units for multiplication, where it is the only condition to have matching units.

The last feature of this method is finding primal dimension, it enables to, if possible, to find different units for same dimension and to express one through another. If impossible, the system will report error.

6. ADVANTAGES AND DISADVANTAGES OF STATIC CODE ANALYSIS AND REPORTS APPROACHES

Approaches described in this paper have virtues and flaws which make them more or less convenient for certain situations. Erwig and Burnett (2002) presented the base of this whole category. Based on header, unit inference is performed and then, errors are reported if no rule of well-formed units can be applied. The good side is that errors are reported immediately after entry. The main flaw is a narrow scope of different spreadsheet and formula that can be checked.

In paper Ahmad, Antoniu, Goldwater and Krishnamurthi (2003), authors proposed approach, with relations “is-a” and “has-a”, and based on them, rules for unit inference based on operations are used. There are different cases, depending on which characteristics of formula elements are common and which are not, and based on that, resulting units are defined. Errors are reported in case that there is no combination of common characteristics and operations found. Advantage of this method is that it can be applied in many fields, without knowing much about the area where spreadsheet is used. It doesn’t require predefining units and it is not restricted to only one or small number of areas. The main flaw of this approach is the lack of header inference, it is necessary to write dimensions in the same way every time. Also, small number of operations is defined: adding, reducing, multiplication and dividing, but also concatenation.

According to Chambers and Erwig (2009), the analysis is performed in three steps. First, on header level, the second is based on labels, which are analyzed by parsing and finding known units that are used. The third level is based on formula in cells which have rules defined. The approach has three levels and it makes it more efficient than each of them separately. Shortcoming is that it includes assumptions, as it is shown in the example “Total” header where it is guessed that it is $. The positive is that values of same dimensions can be compared even if indifferent dimensions.

The approach shown by Chambers and Erwig (2010) can be characterized as the most complete. This approach presents a combination of different methods and contains the previous methods. Except mentioned, approach has two new features: it doesn't detect errors based on well-formed units, but it combines all units into one, and all it takes is these dimensions to match and the cell will be considered correct. Dimensions are inferred in three situations: horizontally and vertically, horizontally or vertically, or no dimensions at all.

All the approaches are used for simple spreadsheet models and simple calculus in maximum two dimensions. Calculus is checked and cells that might contain errors are reported. They are used for only one table in a spreadsheet, while they cannot be used for putting few tables into one. Also, there are no checks if there are all the elements required in the formula. As it can be concluded based on the approaches presented, there is enough room for improvement of these methods that will enable discovery of errors that occur often.

7. CONCLUSION AND FUTURE RESEARCH

Analysing existing approaches and methods for error detection and potential types of errors that might occur, future research should be pointed to approaches that will enable finding errors that are not included in mentioned methods and on implementing existing methods in new situations, aiming to improve spreadsheet models' reliability.

Existing approaches were tested on a small number of spreadsheets and mainly require more or less efforts from end users in order to test the spreadsheet. The goal of future research is to minimize user efforts required in spreadsheet error detection process and lower dependence of data form in spreadsheet.

Future research directions also consider development of approach that will identify errors on many levels, especially those that were made during database manipulation. In case of database with many columns, each column represents a new dimension where the datum is located depending on its value. In existing models, one or two dimensions are checked, while in case of database, error check would have to be done in a large number of dimensions in order to check if some operation makes sense. If some operation over some data will get a result that is meaningful to the user. To be more precise, it is checked if it is possible to relate the result with some existing or a new dimension that represents a combination of the existing ones.

Another functionality of spreadsheets that is not checked enough, but yet, used very often, is "VLOOKUP" function, used for transferring data from one database to another by using common parts. Often, users skip some data in the formula which results in not finding a value that exists. Also, different formats in the database cause "VLOOKUP" not to find some value, even if it exists in the spreadsheet. The idea is to create an application that will check the type and scope of formula data, and in case of data in the same column, but not of the same format, it should report potential error.

Another potential improvement might be improving existing Excel methods for checking values and formats of adjacent cells. Potential options will be considered in the future, in order to add some new functionality that will lead to lowering error probability.

REFERENCES

Ahmad, Y., Antoniu, T., Goldwater, S., & Krishnamurthi, S. (2003, October). A type system for statically detecting spreadsheet errors. In Automated Software Engineering, 2003. Proceedings. 18th IEEE International Conference on, 174-183. IEEE.

Chambers, C., & Erwig, M. (2009). Automatic detection of dimension errors in spreadsheets. Journal of Visual Languages & Computing, 20(4), 269-283.

Chambers, C., & Erwig, M. (2010). Reasoning about spreadsheets with labels and dimensions. Journal of Visual Languages & Computing, 21(5), 249-262.

Cunha, J., Erwig, M., & Saraiva, J. (2010, September). Automatically inferring classsheet models from spreadsheets. In Visual Languages and Human-Centric Computing (VL/HCC), 2010 IEEE Symposium on,93-100. IEEE.

Đorđević, L., & Lečić-Cvetković, D. (2015). Pregled i komparacija pristupa za detekciju i analizu grešaka u spredšitovima. Info M, 14(56), 11-16.

Erwig, M., & Burnett, M. (2002). Adding apples and oranges. In Practical Aspects of Declarative Languages,173-191. Springer Berlin Heidelberg.

Jannach, D., Schmitz, T., Hofer, B., & Wotawa, F. (2014). Avoiding, finding and fixing spreadsheet errors–a survey of automated approaches for spreadsheet QA. Journal of Systems and Software, 94, 129-150.

Luckey, M., Erwig, M., & Engels, G. (2012). Systematic evolution of model-based spreadsheet applications. Journal of Visual Languages & Computing, 23(5), 267-286.

Rajalingham, K., Chadwick, D. R., & Knight, B. (2008). Classification of spreadSheet errors. arXiv preprint arXiv:0805.4224.

Teo, T. S., & Tan, M. (1999). SpreadSheet development and 'what-if'analysis: quantitative versus qualitative errors. Accounting, Management and Information Technologies, 9(3), 141-160.

AN OPTIMIZATION-SIMULATION APPROACH TO ADVERTISEMENT PLACEMENT PROBLEM

Stefan Marković*[1], Mirko Vujošević[1]
[1]Faculty of organizational sciences, Belgrade, Serbia
*Corresponding author, e-mail: stefan_kv_87@yahoo.com

Abstract: *A stochastic programming problem with a number of random parameters in the set of constraints is considered. An iterative optimization-simulation approach is applied as solving method. It consists of two phases: optimization phase, which includes solving a deterministic counterpart of the original chance-constrained problem, and a simulation phase in which the original constraints are checked using Monte Carlo simulation. One iteration corresponds to one scenario. If the decision maker is not satisfied with results, new scenario is generated in which the deterministic values of stochastic parameters are changed in the direction that will provide a more robust solution. Deterministic counterpart in the new scenario is formulated depending on the result of previous iteration. For that purpose, different heuristics are considered. The main goal is to provide a good insight on the optimization problem under uncertainty by performing relatively small number of iterations. General approach and results of the proposed framework will be illustrated on an advertisement placement example.*

Keywords: *Stochastic programming, Simulation, Chance constraints, Linear programming*

1. INTRODUCTION

Application of operational research techniques in marketing started with the famous theorem for marketing mix optimization in 1954 (Dorfman & Steiner, 1954). That pretty much opened the path for OR techniques implementation to marketing problems. Linear programming and goal programming became the first choices when talking about OR in marketing, and Markov models and various simulation techniques, as well as game theory, were applied in the 1960's and 70's (Montgomery, 1970). Even in these early days of interaction between OR and marketing, researchers observed the stochastic nature of marketing problems, through utilizing the theory of decision making under uncertainty (Pratt, Raiffa, & Schlaifer, 1995). Not much was done in the upcoming years on this field, but recently, due to substantially increased computational capacities of computers, modeling uncertainty through various estimation techniques has found its place in OR applications in marketing (Rossi & Allenby, 2003).

Consequently, stochastic programming is not new to marketing, but generally wasn't the main focus of the researchers at the beginning. Nevertheless, it has sprung a new interest among researchers in various fields of marketing problems.

Even with the abundance of research material and the long history of marketing models, it is an observed fact that these models are rarely used for decision making in practice. Advertising, as a part of the marketing mix, was particularly researched, and researchers deemed its effects on sales and market share to be doubtful. This particular opinion was created due to concerns that advertising might have no effect on sales at all, but since (Clarke, 1976), (Leone & Schultz, 1980) and (Vidale & Wolfe, 1957) confirmed that advertising has a positive influence on sales, all suspicions on effectiveness of these models and its application in decision making could be dismissed. Naturally, a lot of effort was put into developing models that could optimize the allocation of an advertising budget, which is also the task at hand of this paper.

Still, because of the stochastic nature of marketing problems, many of them will remain intractable to ordinary mathematical solution (Kotler, 1963). But, complying with the saying: "When all else fails, simulate!" an optimization-simulation approach is put forward and applied to the advertising placement problem.

Stochastic programming allows decision makers to incorporate a measurable uncertainty in a model, which means e.g. that uncertainty can be expressed through appropriate distribution of data or in some other way.

Stochastic programming has applications in a great number of areas and classes of problems, and in this paper, a class of marketing models is considered, namely the marketing campaign model. The reason why the field of marketing is chosen, is due to stochastic nature of the marketing problems. Thus, the observed

problem is a perfect match for the use of a new approach to stochastic programming that is being proposed. The task at hand will be to minimize the cost for a marketing campaign by placing advertisements in various newspapers, which is done exclusively through printed editions of newspapers and magazines, while reaching the needed views and scores both in total population, and within target groups.

As for the solving method, an original approach is proposed, an iterative optimization-simulation approach to stochastic programming.

The paper is organized as follows. Section 2 gives a short overview of stochastic and robust programming and shows how both of them fit into the proposed solving method. Section 3 is the part of paper where the model is formulated, i.e. mathematical model and its notation and a short explanation of the optimization task. Section 4 is reserved for detailed description of the proposed optimization-simulation approach. All the steps of the iterative process are presented, both in words and graphically. The results of research are presented in the Section 5. Concise results are given through tables and diagrams for every scenario used. Section 6 summarizes the conclusions.

2. STOCHASTIC AND ROBUST OPTIMIZATION

Every attempt of modeling a real life problem means facing an uncertain, incomplete or erroneous data. One can differentiate between stochastic and robust optimization when handling uncertainty in models. Robust optimization consists of several approaches for which common goal is to protect the decision maker from any uncertainty in the parameters and from stochastic uncertainty (Gabrel, Murat, & Thiele, 2014). The basic presumption of robust optimization is the existence of such constraints that must always be satisfied, no matter what the realization of the uncertain parameters are (Gorissen, Yanıkoğlu, & den Hertog, 2015). In addition, every uncertain parameter has to get its value from a predefined set.

Stochastic linear programming was first defined in 1955 (Tintner, 1955), and the same year, (Beale, 1955), (Dantzig, 1955) developed an approach that was based on recourse costs and the method was named linear programming with uncertainty. Several years later, (Charnes & Cooper, 1959) defined a new approach in stochastic programming called the chance constrained programming, which differed greatly from the previous two approaches.

There are different methods to incorporate uncertainty in a mathematical model. Theory suggests that most of them are based on defining a new deterministic counterpart, or deterministic replacement, of the original problem. As for solving these models, there is an approach of simplifying the real problem so it can be solved with standard mathematical methods; while on the other hand, there are simulation and optimization techniques that are commonly used in practice (Beyer & Sendhoff, 2007).

Nevertheless, stochastic programming is less conservative compared to robust approach, which is generally orientated on the worst-case scenario when creating a deterministic equivalent of the original problem. The previous statement is valid only on the condition that distributions of random variables in the model are known, or can be calculated. If that's not the case, there are a lot of problems to be expected in solving the deterministic counterpart of the original problem, and often one won't even be able to find any solution for such uncertain parameters. Still, as (Ben-Tal, El Ghaoui, & Nemirovski, 2009) state in their book, stochastic and robust programming are complementary approaches for optimization under uncertainty, which is the approach that will be used in this paper.

3. PROBLEM FORMULATION

The problem of selecting the optimal number of advertisements to be placed in different newspapers is considered. Besides the obvious task of determining the number of advertisements, their positions and size for every newspaper has to be determined as well, while reaching the needed views and scores both in total population, and within target groups. The goal is to achieve all these with the minimum cost possible. Daily, weekly and monthly newspapers, their total views, as well as rating for each newspaper for the targeted group are considered. Ratings are data with a stochastic nature, and are assumed to have a Gaussian distribution. The cost of advertising is set in accordance with real life data. The problem is formulated as a linear stochastic programming model.

Notation
I - Set of newspapers (daily, weekly and monthly)
J - Set of possible positions in all newspapers
P - Set of possible positions for every single newspaper

T - Set of target groups

S - Minimum number of unique advertisement views
c_{ij} - Price for each position in every newspaper
v_i - Number of newspaper views
r_{ik} - Newspaper rating for every target group
p_j - Visibility percentage for every advertisement position
t_k - Wanted rating for a target group
m - Minimum number of advertisement in i newspaper
h - Maximum number of advertisement in i newspaper
g - Minimum number of advertisement on j position
d - Maximum number of advertisement on j position

x_{ij} - Number of j advertisement in i newspaper

Mathematical model

With reference to introduced notation, the advertisement placement model is presented:

Minimize

$$f(x) = \sum_i \sum_{j \in P} c_{ij} x_{ij} \tag{1}$$

subject to constraints

$$\sum_i v_i \sum_{j \in P} p_j \sum_i \sum_{j \in P} x_{ij} \geq S \tag{2}$$

$$\sum_i \sum_{k \in T} r_{ik} \sum_i \sum_{j \in P} x_{ij} \geq t_k \tag{3}$$

$$\sum_{j \in P} x_{ij} \geq m_i \tag{4}$$

$$\sum_{j \in P} x_{ij} \leq h_i \tag{5}$$

$$\sum_i x_{ij} \geq g_j \tag{6}$$

$$\sum_i x_{ij} \leq d_j \tag{7}$$

Constraint (2) sets the minimum wanted total advertisement views; constraint (3) sets the wanted rating for every target group; constraints (4) and (5) set the minimum and maximum number of possible advertisement for every newspaper, respectively; and constraints (6) and (7) set the minimum and maximum number of possible advertisement that can be placed on the assigned positions for every newspaper, respectively.

4. OPTIMIZATION-SIMULATION APPROACH

The proposed solving method is an iterative optimization-simulation approach. It consists of two phases, the optimization phase, where scenarios are generated and the deterministic model is solved, and a simulation phase where the validity of scenario is checked.

Applying the robust approach to creating a deterministic counterpart of the original model will result in a model that is immune to uncertainty. Obtained solution will always be admissible despite any realizations of uncertain parameters. An obvious downside of this approach is that the value of the criterion function is the worst possible. This is why this approach is also called the pessimistic approach, or the worst-case scenario approach. In reality, realizations of uncertain parameters that result in a worst-case scenario are highly unlikely. The goal isn't to model an extreme case, but to handle general uncertainty and that is why the chance-constrained approach is used and combined with robust approach in the solving method.

This approach is about replacing an original problem with a new, deterministic model that will provide the best solution under the condition that constraints are satisfied with a predefined probability. Generating a new deterministic counterpart of the original model corresponds to one scenario. Obviously, this approach will require defining a considerable amount of scenarios that need to be checked, in order to find a scenario

that will achieve the wanted probability of satisfying the constraints. The upside is that one's able to better understand the original problem with every iteration.

The second phase of the method uses the power of simulation to check the generated scenario.

Upon solving the deterministic counterpart of the original problem in the first phase, optimal solution is obtained, which is needed in order to determine the probability of satisfying the stochastic constraints. Next, a random deterministic value for every uncertain parameter from its predefined set with assigned distribution is selected. This way a matrix of random deterministic values of uncertain parameters is generated, or in other words, the randomness of stochastic data is simulated. The constraints are checked if they are satisfied or not by taking into account the deterministic values and optimal solutions of the scenario generated in the first phase.

These simulations are repeated N times, generating N of these matrices, inserting the numbers into the constraints and then calculating if they are satisfied or not. By counting the times when constraints were satisfied, the probability for satisfying stochastic constraints can be calculated, with the following formulae: (Number of cases when constraint was satisfied/Total number of cases N) *100. This is done for every constraint in model.

This approach works under the presumption that the decision maker is willing to accept a certain risk that the constraints won't be satisfied. In return, the value of the criterion function will be better than if the decision maker was to remove all uncertainty and accept the robust approach. If the decision maker is not satisfied with the results, a new scenario will be created, i.e. a new deterministic counterpart of the original problem, and the whole procedure will be repeated again. New scenario will be formulated depending on the results of the previous one, and the goal will be to find such a scenario that meets the minimum criteria set by the decision maker in terms of chance that constraints are satisfied, while trying the find the best possible value of the criterion function.

The main issue of the whole procedure is scenario generation and how to define a new deterministic counterpart of the original problem. There is no iron rule in scenario generation, and it is strongly suggested to use different heuristics. Particular heuristics used will depend on the nature of the problem that is considered, the assumed distribution of the random data, past data available, experience of the decision maker and of the specific problem that is being considered.

For every heuristic to be meaningful, a general target goal must be known, or set. Decision makers usually require a high percentage of constraints satisfaction. Therefore, stochastic constraints are usually divided into two groups. The first group is the so-called "hard" constraints group, and decision maker demands that these constraints must have p_i levels that are 100%. The second group is the "soft" constraints group and decision maker accepts a certain risk that these constraints won't be satisfied. Usual p_i levels for these set of constraints are above 90 - 95%. The idea of dividing constraints in LP model to hard and soft ones was first introduced in (Kendall, 1975) and is used in this paper as well. One can make further groups of constraints, but these are the general guidelines of how this specific problem was modeled in this paper.

Two starting scenarios should be the scenario with the expected values, and a robust scenario. Using these two scenarios as border cases provides the initial insight in the nature of the problem and stochastic data. The only thing that's left is to test different scenarios, and that is why iterative approach is very handy. If facing the usual problem of high p_i levels (above 90%), then sticking close to robust scenario provides the greatest possibility that constraints will be satisfied. Have in mind though that not getting to close to the robust scenario is also a prerequisite, because getting to close to this scenario will translate in a worse criterion function. Therefore, the general approach will be to make a tradeoff between the robustness of the model and the value of its criterion function.

The whole approach is summarized in Figure 1.

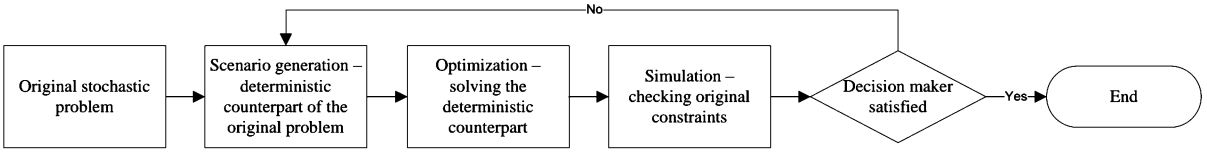


Figure 1: Optimization-simulation approach

The proposed solving method will be applied, namely optimization-simulation approach to stochastic programming, to the advertisement placement model presented in Section 3 and the results will be presented in the following chapter.

5. COMPUTATIONAL TESTING AND RESULTS

Let's take another look at the model presented in the section 3. The stochastic nature of the model is reflected in equation (3), and its set of constraints. The obvious reason is the stochastic parameter r_{ik}, which represents the newspaper rating for target groups. The reason why these parameters are stochastic is that these ratings represent the evaluation of the observed newspaper ratings. These ratings are calculated based on the number of copies printed, newspaper reputation and tradition and the assumed ratings for the position of advertisement placed in those newspapers. The method that is used to calculate these parameters is not in the focus of this paper, but what's important here is that these parameters are calculated monthly and adjusted on a six month period. For the purpose of the model, a case where uncertain parameters have a Gaussian distribution with expected value - μ and variance - σ is considered.

There are fourteen different target groups, which gives us a set of 14 stochastic constraints to be considered in total. This set of constraint is denoted as "soft" constraints, while all the other constraints are viewed as "hard" constraints. Since "hard" constraints must always be satisfied, they won't be considered in the optimization-simulation approach.

These target groups, and consequently the set of stochastic constraints, can be classified in four groups:

- Gender: the first two constraints define the minimum wanted rating achieved within male and female population,
- Age: there are six different age categories that are considered, and consequently the same number of constraints that define minimum wanted ratings within every age group,
- Geographic location: the model differentiates between three geographic locations where newspapers are sold, hence the minimum ratings that need to be achieved within the assigned geographic region are set,
- Education: three education levels are considered, and minimum ratings are assigned for them.

The set of 14 stochastic constraints become chance constraints with a predefined probability level of satisfaction in the following manner:

$$\left[\sum_{i}\sum_{k\in T} r_{ik}\sum_{i}\sum_{j\in P} x_{ij} \geq t_k\right] \geq p_i, i = 1,...m$$

Decision maker sets the p_i level for every constraint.

Decision maker owns a chain of supermarkets and therefore wants to target a specific group through advertising. His focus and target group are women that are between 40 and 49 years old, from the geographical region G1 and have a university degree. This means that second, sixth, ninth and fourteenth constraint need to have the highest p_i level. Decision maker is willing to accept less than 0,5 percent risk that these constraints won't be satisfied, which means that p_i levels for these four constraints need to be higher than 99,5%. For all other constraints decision maker is willing to accept a 5% risk, namely, p_i levels are equal or higher than 95%. This is presented in the Table 1.

Table 1: Probability levels for soft constraints

Constraint	Gender		Age						Geographic region			Education		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
p_i (%)	≥95	**>99.5**	≥95	≥95	≥95	**>99.5**	≥95	≥95	**>99.5**	≥95	≥95	≥95	≥95	**>99.5**

Decision maker divided the set of soft constraints by selecting one constraint from each of the four groups of constraints, by accepting a minimal risk for these constraints not to be satisfied. In return, the decision maker demands at least 15% in currency spent less than if the robust approach was to be used on this model. So the tradeoff is described by accepting certain levels of risk in return for at least 15% better value of criterion function.

Having this in mind, the results of computational testing of proposed scenarios will be presented, as well as the general guidelines used for scenario generation.

Table 2: Computational results

Con	S1	p_i	S2	p_i	S3	p_i	S4	p_i	S5	p_i	S6	p_i
1	μ	50.61	μ-0.1 σ	57.15	μ-0.2σ	61.84	μ-0.3σ	68.81	μ-0.4σ	76.40	μ-0.5σ	81.51
2	μ	77.69	μ-0.1 σ	85.31	μ-0.2σ	88.64	μ-0.3σ	92.73	μ-0.4σ	93.36	μ-0.5σ	96.18
3	μ	96.48	μ	98.83	μ	97.30	μ	99.21	μ	98.18	μ	97.74
4	μ	55.49	μ-0.1 σ	62.22	μ-0.2σ	62.31	μ-0.3σ	65.95	μ-0.4σ	68.59	μ-0.5σ	72.00
5	μ	50.21	μ-0.1 σ	56.46	μ-0.2σ	61.89	μ-0.3σ	66.87	μ-0.4σ	72.08	μ-0.5σ	77.76
6	μ	84.16	μ-0.1 σ	89.44	μ-0.2σ	92.31	μ-0.3σ	96.02	μ-0.4σ	96.84	μ-0.5σ	98.08
7	μ	65.80	μ-0.1 σ	72.97	μ-0.2σ	77.33	μ-0.3σ	83.70	μ-0.4σ	87.75	μ-0.5σ	91.85
8	μ	50.60	μ-0.1 σ	56.59	μ-0.2σ	62.55	μ-0.3σ	68.76	μ-0.4σ	73.79	μ-0.5σ	80.38
9	μ	85.94	μ-0.1 σ	90.84	μ-0.2σ	93.58	μ-0.3σ	96.09	μ-0.4σ	97.27	μ-0.5σ	98.47
10	μ	64.57	μ-0.1 σ	70.60	μ-0.2σ	74.92	μ-0.3σ	82.51	μ-0.4σ	86.10	μ-0.5σ	90.20
11	μ	55.41	μ-0.1 σ	62.91	μ-0.2σ	66.62	μ-0.3σ	74.00	μ-0.4σ	78.43	μ-0.5σ	85.03
12	μ	99.70	μ	99.93	μ	99.94	μ	99.98	μ	99.99	μ	100
13	μ	96.73	μ	98.58	μ	98.30	μ	99.52	μ	99.34	μ	99.53
14	μ	88.99	μ-0.1 σ	92.08	μ-0.2σ	93.15	μ-0.3σ	95.83	μ-0.4σ	96.62	μ-0.5σ	97.77
f(x)	22.355.928		22.507.346		22.666.504		22.822.944		23.001.124		23.202.696	

Table 3: Computational results

Con	S7	p_i	S8	p_i	S9	p_i	S10	p_i	S11	p_i	Srob	p_i
1	μ-0.6σ	89.23	μ-0.7 σ	88.96	μ-0.8σ	94.32	μ-0.9σ	96.58	μ-0.9σ	98.64	μ-3σ	100
2	μ-0.6σ	97.24	μ-0.7 σ	99.33	μ-0.8σ	99.00	μ-0.9σ	99.50	μ-0.9σ	99.81	μ-3σ	100
3	μ	99.21	μ	99.61	μ	98.22	μ	98.38	μ	99.94	μ-3σ	100
4	μ-0.6σ	76.61	μ-0.7 σ	78.48	μ-0.8σ	80.48	μ-0.9σ	82.14	μ-1.5σ	96.66	μ-3σ	100
5	μ-0.6σ	84.55	μ-0.7 σ	87.95	μ-0.8σ	90.79	μ-0.9σ	94.31	μ-1σ	97.72	μ-3σ	100
6	μ-0.5σ	99.03	μ-0.5 σ	99.69	μ-0.5σ	99.85	μ-0.5σ	99.88	μ-0.5σ	99.90	μ-3σ	100
7	μ-0.5σ	95.14	μ-0.5 σ	97.83	μ-0.5σ	98.16	μ-0.5σ	99.02	μ-0.5σ	99.42	μ-3σ	100
8	μ-0.6σ	85.39	μ-0.7 σ	90.57	μ-0.8σ	93.23	μ-0.9σ	96.27	μ-0.9σ	96.21	μ-3σ	100
9	μ-0.6σ	99.17	μ-0.7 σ	99.62	μ-0.8σ	99.63	μ-0.9σ	99.85	μ-0.9σ	99.95	μ-3σ	100
10	μ-0.6σ	94.40	μ-0.6 σ	97.22	μ-0.6σ	97.87	μ-0.6σ	98.98	μ-0.6σ	99.09	μ-3σ	100
11	μ-0.6σ	89.81	μ-0.7 σ	93.79	μ-0.8σ	95.02	μ-0.8σ	97.22	μ-0.8σ	98.81	μ-3σ	100
12	μ	100	μ	100	μ	100	μ	100	μ	100	μ-3σ	100
13	μ	99.86	μ	99.92	μ	99.84	μ	99.91	μ	99.99	μ-3σ	100
14	μ-0.6σ	98.92	μ-0.7 σ	99.36	μ-0.7 σ	99.39	μ-0.7σ	99.69	μ-0.7σ	99.85	μ-3σ	100
f(x)	23.397.780		23.575.284		23.774.668		23.986.632		24.261.686		29.737.023	

In the two tables above, Table 2 and Table 3, the computational results of our scenario testing are presented. Scenario 1 and robust scenario are two border cases, and scenarios are generated between these two cases. In the first column, there is an indication to what the new deterministic equivalent is set to, and the following column presents the probability of satisfying the chance constraints of the scenario using the simulation approach described earlier. Each scenario is run through 10.000 simulations and appropriate probabilities are calculated and presented in the table. Value of the criterion function is presented accordingly for every scenario. Shaded cells indicate that there were changes made to the scenario for assigned constraint, relative to the previous scenario, meaning every change in creating a new scenario is marked in this fashion. This shows the approach, or heuristic, used to obtain wanted probabilities.

Now, a few words of the heuristic used. Starting from the expected values as the border case, deterministic realizations of the stochastic parameters are slowly moving towards a robust scenario that provides the highest probability of satisfying the constraints. However, three constraints were already satisfied with the probability over 95%, so it is decided not to change these stochastic values of parameter r_{ik}. Other constraints were not satisfying so scenarios were created towards the robust case by reducing the expected value by 0,1 σ in each scenario, keeping an eye on the p_i levels.

The basic presumption was that there is a strong positive correlation between constraints within their respective groups. Namely, in the set of constraints annotating the age a positive correlation between them was hypothesized. In terms of generating scenarios, this means that by satisfying one constraint of the group, the p_i levels of all the other constraints in that group will also be increased. Of course, it is assumed that these correlations are stronger between constraints that denote similar ages, like the age of 30-39 and the 40-49 years, than when there is a large age difference, like 12-19 and older than 66 years.

For the set of constraints that denote geographical regions, the same presumption is applied, as well as for the education. The only difference is on the set of constraints denoting gender. It is also assumed that there is a positive correlation between male and female population, but on a much lower level than in the other three set of constraints. This is to be expected considering different interests in newspapers for male and female population.

What this hypothesis actually means when generating a new scenario is that it won't be necessary to create a scenario that is getting closer to a robust one and one can still expect a certain increase in probability levels for a constraint if we have already decreased the value of a stochastic parameter in a constraint that is within the group of interest. For example, let's look at the constraints six and seven in scenarios S6 through S11. Stochastic parameter r_{ik} for these two constraints was set to μ-0.5σ in the scenario S6. Probability levels are 98,08% and 91,85% respectively. Our goal is to achieve probability level greater than 99.5%, and equal or greater than 95%. Yet, the value of stochastic parameters was kept the same, μ-0.5σ, all the way to the last scenario S11, and a steady increase in probability levels through every scenario afterwards is observed. This confirms the hypothesis of positive correlation within groups of constraints. The same pattern is used for other constraints, so the wanted probabilities in the last scenario were achieved.

The other very important advantage of this heuristic is that by keeping scenarios as far away as possible from the robust scenario, a better value of the criterion function is been generated. By applying this heuristic, both of the prerequisites for a good scenario are achieved: high probability levels for constraint satisfaction, and a better value of criterion function. Even though these two goals may seem opposed to each other, meaning that higher probability levels of satisfying constraints translates into an unfavorable value of a criterion function, the model still managed to achieve them both by applying the proposed heuristics and an iterative optimization-simulation approach.

Figure 2 shows the graphical results of the computational testing of scenarios:

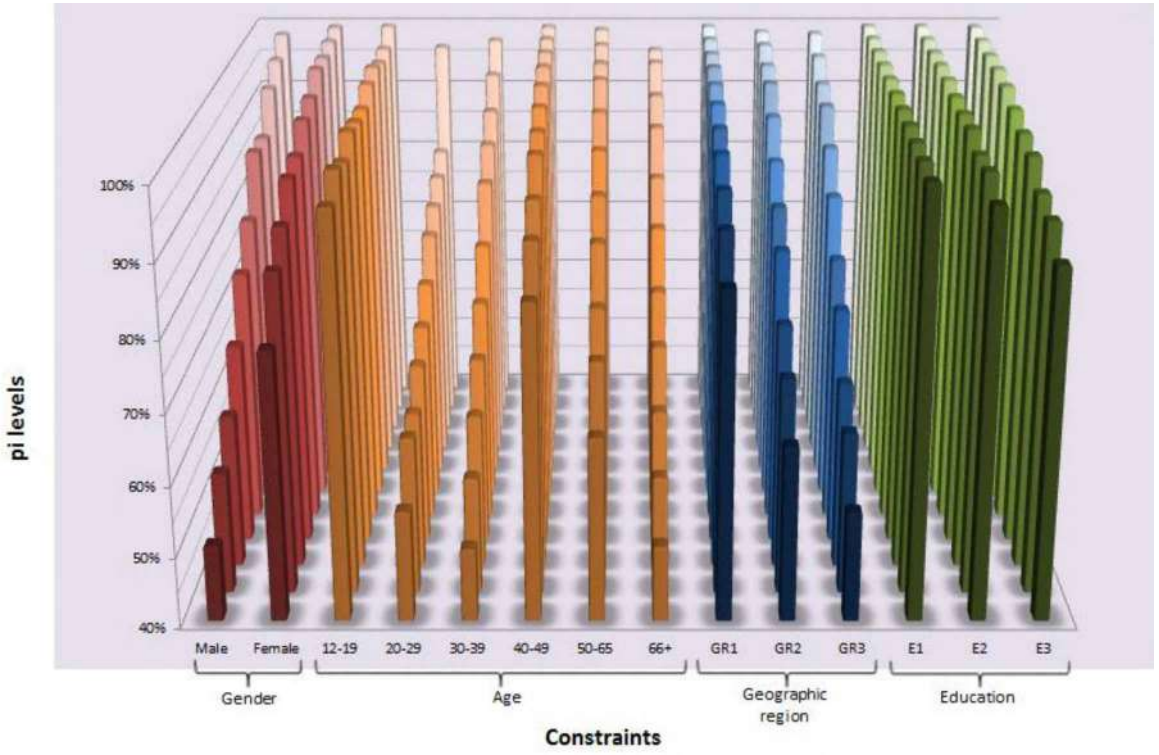


Figure 2: Graphical representation of computational results

Each group of constraints has its own color, and there are total of eleven scenarios presented here, all but the robust one. This chart shows how p_i levels increase with every new scenario.

6. CONCLUSION

In this paper, an original approach for tackling uncertainty in a model was put forward and general guidelines of how to use an optimization-simulation approach to stochastic linear programming in practice was given. Combining chance constraint approach and a robust approach to a problem with stochastic parameters is the foundation of the framework. In addition, using the power of simulation to check probabilities of chance constraints is the backbone of the approach. Advertisement placement model, which is by its nature a stochastic problem, is used to show how the optimization-simulation model works in practice. By using the proposed heuristics, one is able to generate valid scenarios to be optimized and checked through simulation. Understanding a specific problem is of essence when generating scenarios and applying the proposed framework. Incorporating the preferences of the decision maker is also an important part of the model.

Numerical and graphical results of the proposed approach on an advertisement placement model are also provided. The approach is intuitive and easy to understand and apply to real life problems.

Acknowledgement:

The author is a scholar of the Ministry of education, science and technological development.

REFERENCES

Beale, E. M. L. (1955). On minimizing a convex function subject to linear inequalities. *J Royal Statistical Society*. http://doi.org/10.2307/2983952

Ben-Tal, A., El Ghaoui, L., & Nemirovski, A. (2009). *Robust Optimization*. New Jersey: Princeton series in applied mathematics. http://doi.org/10.1007/s10957-013-0421-6

Beyer, H.-G., & Sendhoff, B. (2007). Robust optimization – A comprehensive survey. *Computer Methods in Applied Mechanics and Engineering*, *196*(33-34), 3190–3218. http://doi.org/10.1016/j.cma.2007.03.003

Charnes, A., & Cooper, W. W. (1959). Chance-Constrained Programming. *Management Science*, *6*(1), 73–79. http://doi.org/10.1287/mnsc.6.1.73

Clarke, D. G. (1976). Econometric Measurement of the Duration of Advertising Effect on Sales. *Journal of Marketing Research*, *13*(4), 345–357. http://doi.org/10.2307/3151017

Dantzig, G. B. (1955). Linear Programming Under Uncertainty. *Management Science*, *1*(3), 197–206. http://doi.org/http://dx.doi.org/10.1287/mnsc.1.3-4.197

Dorfman, R., & Steiner, P. O. (1954). Optimal Advertising and Optimal Quality. *The American Economic Review*, *44*(5), 826–836. Retrieved from http://www.jstor.org

Gabrel, V., Murat, C., & Thiele, A. (2014). Recent advances in robust optimization: An overview. *European Journal of Operational Research*, *235*(3), 471–483. http://doi.org/10.1016/j.ejor.2013.09.036

Gorissen, B. L., Yanıkoğlu, İ., & den Hertog, D. (2015). A practical guide to robust optimization. *Omega*, *53*, 124–137. http://doi.org/10.1016/j.omega.2014.12.006

Kendall, J. W. (1975). Hard and Soft Constraints in Linear Programming. *Omega*, *3*(6), 709–715.

Kotler, P. (1963). The Use Of Mathematical Models in Marketing. *Journal of Marketing*, *27*(4), 31–41. http://doi.org/10.2307/1248643

Leone, R. P., & Schultz, R. L. (1980). A Study of Marketing Generalizations. *Journal of Marketing*, *44*(1), 10–18. http://doi.org/10.2307/1250029

Montgomery, D. B. (1970). *Applications of management science in marketing*. Englewood Cliffs (N.J.): Prentice-Hall.

Pratt, J., Raiffa, H., & Schlaifer, R. (1995). Introduction to statistical decision theory. Retrieved from http://books.google.nl/books?hl=en&lr=&id=vXXTkkaJqPQC&oi=fnd&pg=PA1&dq=The+Theory+of+Statistical+Decision&ots=yHPL-c1Yjh&sig=-lQkq9fVLXhLIlNmuidZ3h4Nces

Rossi, P. E., & Allenby, G. M. (2003). Bayesian Statistics and Marketing. *Marketing Science*, *22*(3), 304–328. http://doi.org/10.1287/mksc.22.3.304.17739

Tintner, G. (1955). Stochastic linear programming with applications to agricultural economics. In *In H. A. Antosiewicz (Ed.), Proceedings of the Second Symposium in Linear Programming*,197–228.

Vidale, M. L., & Wolfe, H. B. (1957). An Operations-Research Study of Sales Response to Advertising. *Operations Research*, *5*(3), 370. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=7679762&site=ehost-live\nhttp://content.ebscohost.com/ContentServer.asp?T=P&P=AN&K=7679762&S=R&D=bth&EbscoContent=dGJyMNLe80SeprM4wtvhOLCmr0ueqLFSr624S7SWxWXS&ContentCustomer=dGJyMPGut0%2B2qbFIue

RATIONALIZATION OF STORAGE COSTS BY APPLICATION OF MODIFIED SMED METHOD

Dragan Milanovic[1], Aleksandar Nestorov*[2], Mirjana Misita[1]
[1]Faculty of Mechanical Engineering, University of Belgrade
[2]Mecaplast Group, Zrenjanin, Serbia
*Corresponding author, e-mail: anestorov@mecaplast.com

Abstract: *In modern business, the flexibility of production, i.e. the possibility of production of a large number of various products, with minimal storage costs of the material, is one of key factors of the success. This is mostly important in automotive industry where the production is based on Just in Time production and every loss of capacity due to frequent and insufficiently fast changes of tools/forms can easily cause failure to fulfil the daily plan of production. This can caused very big effect, stopping of the production line of the customer. This paper reviews the modified SMED (Single Minutes of Exchange of Die) method by whose application the flexibility and competitiveness of some company can be significantly improved by reducing of the operating costs i.e. for the same spent time it's possible to change production program more time, give us possibility to reduce batch size and space needed to store the goods. This modified SMED method is different from others because for the process of data analyze is used statistical method, t-test, which caused big cost reduction for testing and time needed to performed it. Except that, in the paper is present the significant correlation between results of SMED and way of production planning, with the goal to reduce and stabilize the stock. Multiple benefits of using of SMED method is reflected in the fact that in addition to saving storage space, also getting the flexibility of the production system which enables faster response and adaptation to daily customer's requests.*

Keywords: *SMED method, stock reduction, automotive, flexibility, batch size*

1. INTRODUCTION

In circumstances of adapting to changing requirements of users, one of the problems in the production is appropriate preparation of the machines, and/or preparatory - final time. The duration of the preparation of the machine for the second operation is very frequently very long, which in small quantities in the series, and that is the case when we adapt to changing requirements of users, burdens the production unit by additional time and costs. In an effort to enable as greater adaptability as possible within the observed company, the significant attention is devoted to rationalization of activities within the preparatory - final complex of actions with the aim of their shortening.

The basic idea in realizing the shortening of preparatory - final time is in implementing of all necessary actions while the machine is running, so that the machine would stop only while performing of those activities which cannot be performed while the machine is in motion. Likewise, the duration of all activities on the machine while it is not in motion should be shortened by all available methods and rationalization techniques. Separation of these activities is a key and starting basis for all further efforts, because thus the research is expediently directed in the field of those activities that determine duration of preparatory - final activities.

Globalization of the market has created the need for the production in small batches, by which the increase in the number of machine setting and equipment is conditioned, as well as the reducing of production time of a batch. For these reasons, it is necessary that the replacement of production be faster so that the flexibility does not influence on the speed of the response to a request (Mcintosh et al, 2007).

Goubergen and Landeghem (Goubergen and Landeghem, 2002) have divided various reasons into three main groups:

1. Flexibility : Due to a large number of various products and reduction in their quantities, the company must be able to respond quickly to customer's demand. That is, if it is necessary to produce in small batches, it is of great importance to be able to perform the change of tools in the shortest possible time,
2. Lack of capacity: Every loss, especially in these conditions, even of one minute while changing the tool is a huge loss. Every reduction of time of tool change is directly reflected on the increase in capacity,

3. Reduction in costs: cost of production and storage is in direct conjunction with the machine performances,

According to Haron and Peterson (Harmon & Peterson, 1991) reduction in time necessary for setting is important for three reasons:

- Great expense during a complicated change of tools and setting of the process causes the increase in production series, by which the investing in stocks,
- Rapid and simple technique for tool change reduces the possibility of errors during the equipment setting,
- Reduction and simplification of setting increase the operating time of the machine.

Also, one of key factors for improvement of the process of production change, and it has not been mentioned in any of the above-mentioned analyses, is the production plan. Its importance is great because of adequate and timely preparation of the operators that work on the change, and so that the process be adequately prepared and all external operations done in accordance with the standard. One of the key external operations, for which the exact time of tool change is very important, is pre-heating of tools for the sake of reducing of the time of waiting for warm-up while the tool is in the machine.

Frequent changes of product range on request of the market cause significant percentage of preparatory-final time in the machine running and cannot be eliminated but it only can be minimized by application of appropriate methods.

Since SMED method that Shigeo Shingo has improved is one of the basic, and the others are based on it, in the following, we will deal with its analysis and the results of its application, i.e. its influence on the factors which Harmon and Peterson have singled out, primarily on the inventory levels.

Shingo defends the idea that SMED method is composed of various techniques by which the setting is possibly reduced to less than 10 minutes, or that even the number of necessary minutes for change be reduced to a single digit (Shingo, 1989).

2. THE PREPARATION OF THE EXPERIMENT

The process of tool change is carried out in five steps which are conditioned by one another:

- Stopping of the machine
- Removing of tool
- Inserting of new tool
- Tool change
- Starting of the machine

and duration of tool change counts from the last good part of the last batch to the first good part of the next batch (figure 1).

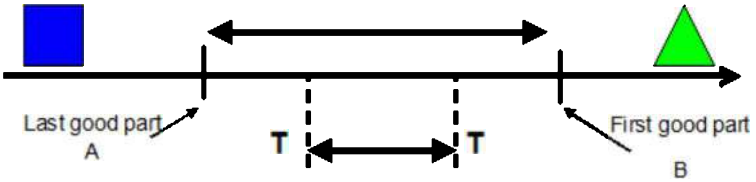


Figure 1: Diagram of the time of tool change (Changeover of Production and Lot sizing, Toll GPE 0097, 11.2010, Mecaplast, Monaco)

The focus in this paper will be on the analysis of the activities that is necessary to be made during one SMED, and their redistribution with the aim that the number of internal operations be as small as possible.
For this purpose it is not necessary to analyse every machine individually, because it has been established by the analysis that the schedule of steps that should be performed on the machines is the same, only the duration of performance of certain steps differs, which can statistically be proved. (Ana Sofia Alves et al, 2009).

For the purpose of this proving we will use t-test, known as "Student's" t-test. There are 3 types of t-test and these are:

- One sample t-test that is commonly used for the comparison of the mean value of one group of data with target mean value,
- Two sample t-test when the mean value of one group of data should be compared with the mean value of the other,
- Paired t-test when we want to compare the values before and after a particular treatment.

Before the application of t-test it is necessary to determine the normality of data of the population of samples with which it is handled. If the distribution of population values of samples is normal, either F-test (if σ levels are compared) or 2 samples t-test (if the mean population values are compared) are used for the comparison. If the distribution of data does not give a normal distribution, the test that is used for the comparison is Levene's test.

The results of data normality test during the tool change on the machines of small tonnage (200t - 550t), and for the data for the machines of large tonnage (550t - 1300t) are represented in the following diagrams (figure 4). As the distribution is normal in both cases, P>0.05, one could continue with the application of some of t-tests which have aimed at proving that two groups of results of 30 samples per each for the machine of 200t and for the machine of 500t, are statistically the same.

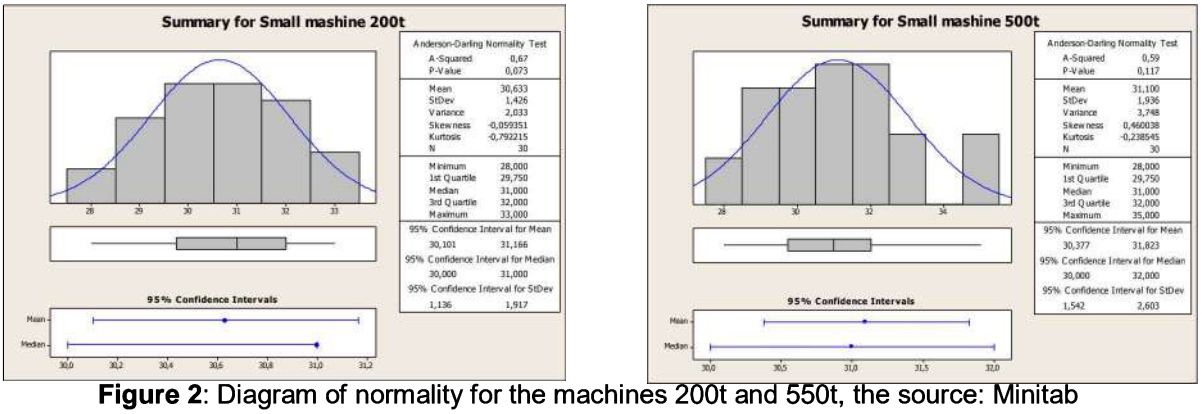


Figure 2: Diagram of normality for the machines 200t and 550t, the source: Minitab

When it comes to the two data populations, and as the mean value of those populations is compared, 2-t test has been chosen as relevant for proving the statistical equality of the two populations.

2 sample t-test consists of the confirmation of null hypothesis (equation 1) and alternative hypothesis (equation 2):

$$H_0 = \mu_1 - \mu_2 = 0 \tag{1}$$

$$\mathrm{H}_1 = \mu_1 - \mu_2 \neq 0 \tag{2}$$

By the confirmation of null hypothesis, if the value is P > α=0.05, where α represents the coefficient of risk (significance level) and its value is usually 5% or 0.05, it is confirmed that the mean values of populations are equal, i.e. that there is no difference between the populations. Otherwise, the null hypothesis is rejected and the alternative hypothesis is accepted. The value P, as well as the other values can be seen in the statement of Minitab, software for statistical data processing (figure 3).

Two-Sample T-Test and CI: Small mashine 200t; Small mashine 500t

```
Two-sample T for Small mashine 200t vs Small mashine 500t

                     N   Mean  StDev  SE Mean
Small mashine 200t  30  30,63   1,43     0,26
Small mashine 500t  30  31,10   1,94     0,35


Difference = mu (Small mashine 200t) - mu (Small mashine 500t)
Estimate for difference:  -0,467
95% CI for difference:  (-1,347; 0,414)
T-Test of difference = 0 (vs not =): T-Value = -1,06  P-Value = 0,293  DF = 53
```

Figure 3: The statement of the results of 2 Sample t-Tests, Minitab

where N represents the number of samples per population, Mean - the mean value for the population, StDev-standard deviation, DF - number of degrees of freedom.
As the value P = 0.293> of the given α=0.05, it means that the null hypothesis is accepted, by which it is confirmed that in the further review, the conclusions that have been drawn for one machine refer to all machines from this group. The identical conclusion has been drawn also for the group of machines over 500t, by which the range of research and number of experiments have significantly reduced, i.e. the number of observations has reduced from 11 to only 2 representative samples from 2 populations of machines. The results of this test have significantly influenced on the reduction in the costs of further analysis.

3. THE PRACTICAL APPLICATION SMED METHOD AND ITS EFFECTS

The method of observation, collection and processing of data in the example of group of machines from 200t to 500t will be shown in the following, with the proviso that at the end the results from both groups of machines and common conclusions will be shown.

Observation, collection, analysis and control have been done on the basis of Shingo's division and distribution of operations (figure 4).

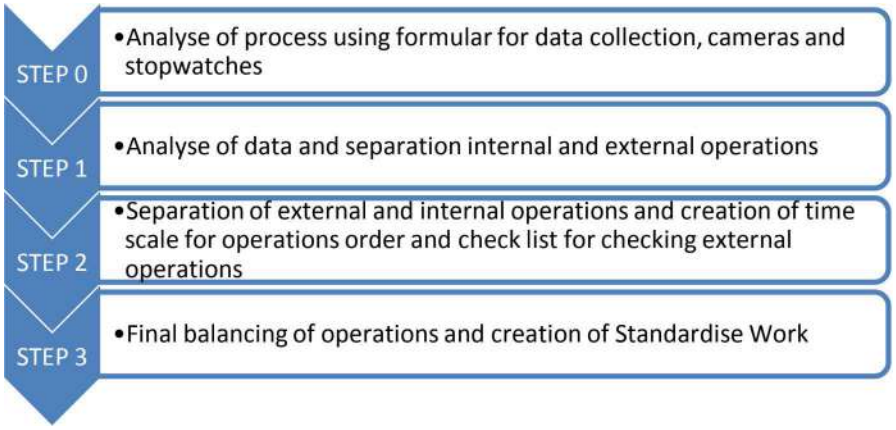


Figure 4: Diagram review of Shingo's method

Step 0 (Internal and External setup): In this step we cannot distinguish what the internal operations are and what the external operations are. It is necessary here to perform the analysis of existing production process with the presence of the operators that are normally engaged in tool change and process setting. It is necessary to analyse the time of every single activity, and by recommendation of Shingo, during this analysis one should use stopwatch, as well as make a movie during the production change.

Observation has been done by synchronous monitoring of two operators, wherein their every activity, its duration, the manner of operator's movement and distance that he has going while performing every single activity have been recorded in the form. As a result, at the end of this form one can see the total duration of all activities, as well as the total distance that each of the operators have gone.

Step 1 (Separation of internal and external operations): In this step it is necessary to separate internal and external operations by the analysis. According to Shingo, this step is extremely important in the implementation of SMED. He claims that, in this step, the total time of setting can be reduced 30% to 50%.

By the analysis of comparative time diagram of operations (figure 5) is the most important in this step, where the duration of every operation has been presented by the line whose length indicates the duration of the operation. Here, in addition to the duration, it can also be seen which activities are mutually ovelapping, or where exists certain waiting at interdependent operations. Based on this and the next diagram (figure 10) it can also be concluded which operations can be performed before stopping of the machine.

Step 2 (Transforming of internal into external operations): in this step it is the most important that the separated internal operations transform into external, i.e. to perform them while the machine still operates.
This involves the activities such as: preparation, check and preheating of tool before the starting of the change itself, i.e. stopping of the machine. Also, check and change of material can be done as external operation. The important precondition for correct performing of the operation of tool preheating as an external operation is the existence of precise plan of production. With precise plan, i.e. precisely defined time of completion of the previous batch, the operator that performs the preparation of tool can start the

preheating of tool on time so that it can be completed by the time when the tool has to be placed in the machine. None of the previous authors has taken this detail into their examination as an important factor in the duration of change. In the case that the tool has not been set on the counter for preheating on time, it happens that the tool, which is insufficiently heated, is inserted into the machine, whereby the time of its heating for the start of production in the machine itself is extended, which directly increases the time of change.

In the checklist of external operations there are the following items that are necessary to be checked before the stopping of the machine: raw material – whether it is appropriate, on the marked place and prepared for production according to the standard, the presence and state of hand tool, presence and state of peripheral equipment for production, the state of connectors and the state of preheating of tool that is prepared for change, documentation on the workplace etc.
By the examination of comparative diagram (figure 6), it can be concluded that the time required for performing the work of the first and second operator is not balanced, and that one should check the possibility of switching of some of the operations, which is performed one of the operators, to the other operator and vice versa, and in order to equate their time and to reduce the total time.

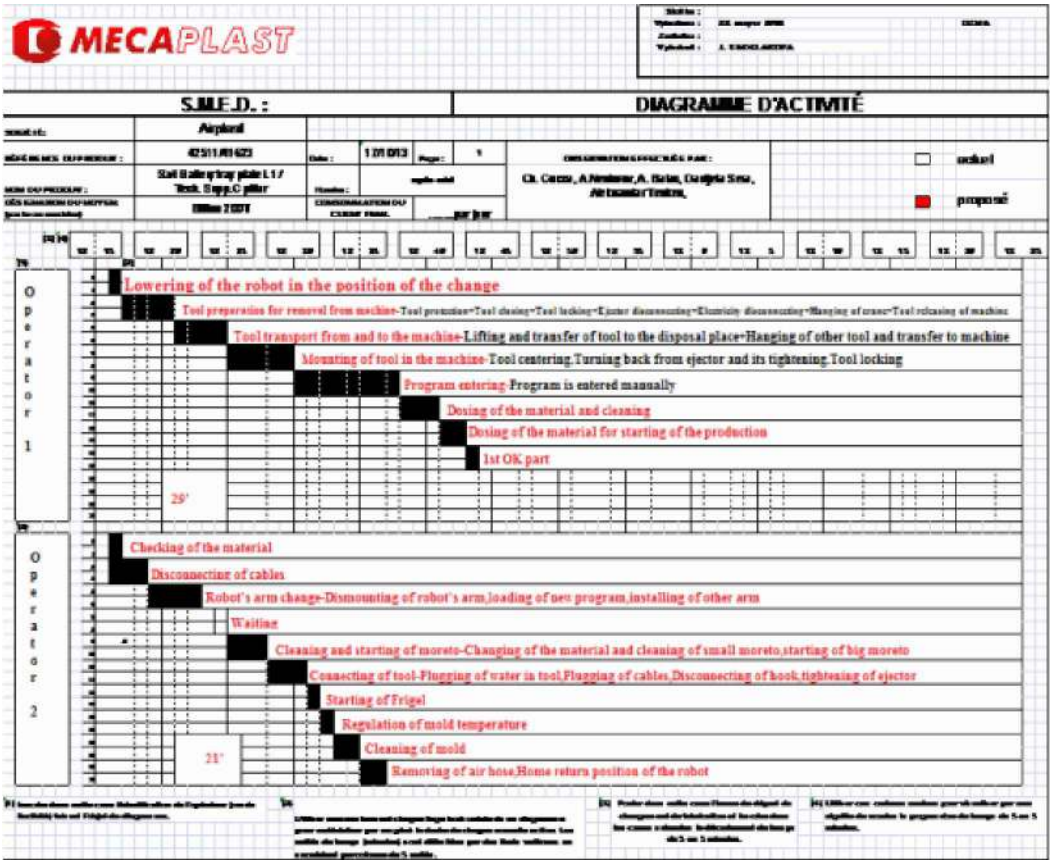


Figure 5: The diagram man - machine, the comparative display of the schedule and duration of operations (Changeover of Production and Lot sizing, Toll GPE 0097, 11.2010, Mecaplast, Monaco

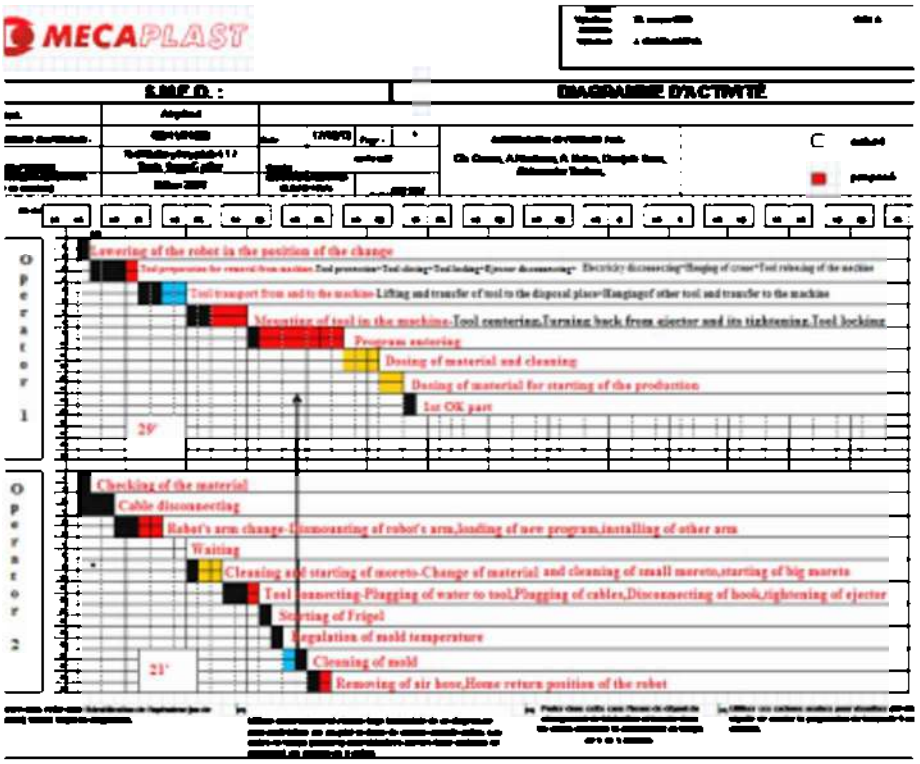


Figure 6: The diagram man - machine, separate external operations and the operations that can be eliminated (Changeover of Production and Lot sizing, Toll GPE 0097, 11.2010, Mecaplast, Monaco

The operations highlighted in yellow (figure 6) are the operations that refer to the material change and cleaning of the dryer of material, and they have been identified as the operations before the machine stops, i.e. they can become the external operations, and they have been placed in the checklist (figure 7). This move would save 5 minutes of the time of the operator 1., and 2 minutes of the operator 2.

As it can be seen in diagram (figure 7), by the application of the first two steps (0,1,2) of Shingo's methodology, the time of the tool change at the operator 1 has been reduced for 62%, i.e. from initial 29 minutes the time of change has reduced to 11 minutes, while at the operator 2 that percentage is 38% (from 21 minutes we have reduced to 13 minutes).

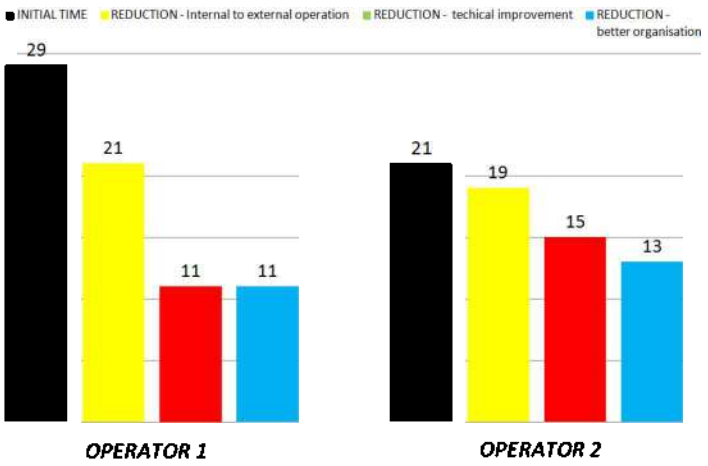


Figure 7: The comparative display of the improvement of SMED by the application of Shingo methodology

Step 3 (final balancing of operations) - By the application of this third step, the final balancing of operations are performed, as well as final reducing and eliminating of unnecessary activities. As it is shown, our 2 operators do not have balanced time of performing of their operations, i.e. the operator 1 finishes his work for 2 minutes earlier than the operator 2. As those 2 minutes, during which the operator 1 does not perform any activity, influence on the extension of total time of tool change, the assignment is to find appropriate activity that lasts 1 minute which performs the operator 2, and shift it to the list of activities of the first operator.

Cleaning of mold, one of last operations of the second operator, has been identified as a potential activity for assigning to the first operator.

After final balancing, both operators have the same final time of 11 minutes, and by which the total time of change has been reduced for yet additional 7,7 %.

Final display of the schedule of the operations is shown in diagram of operations (figure 8).

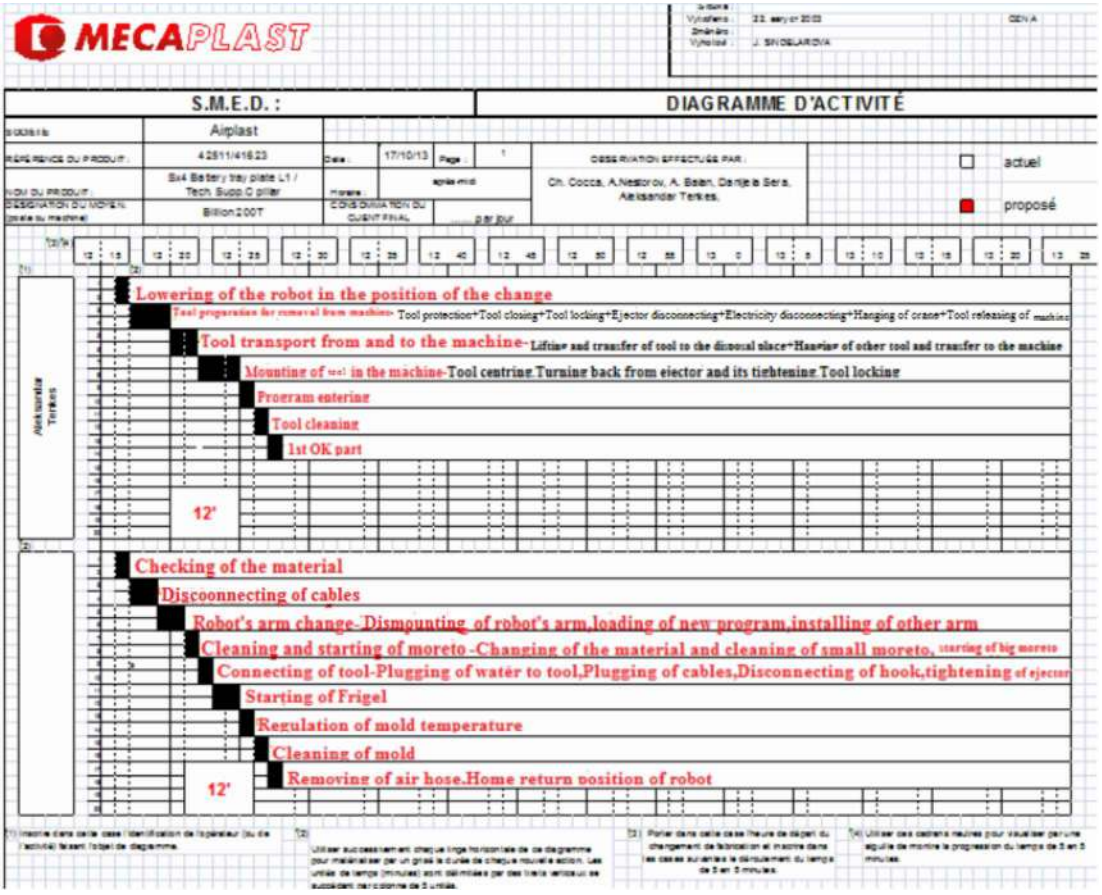


Figure 8: Diagram man-machine, the final display of the schedule of the operations (Changeover of Production and Lot sizing, Toll GPE 0097, 11.2010, Mecaplast, Monaco

The final result of the application of SMED method to both groups of machines is presented in table (table 2) as follows.

Table 1: Comparative display of reducing of tool change by *the application of SMED method*

Group	Initial time average	External set-up operation	Improvement %	Techical improvement	Improvement %	Better organisation	Improvement %	Final balance of operations	Improvement %
Small mashines (200t - 550t)	30	21	***30***	16	***47***	13	***57***	12	*60*
Big mashines (550t - 1300t)	45	35	***22***	32	***29***	30	***33***	27	*40*

As it can be seen from the presented table, by the application of SMED method to these two groups of machines, total time that is necessary for tool replacement has reduced for 60% for the group of small machines, and/or 40% for the group of the machines over 550t.

Reducing of total time of change has influenced on:

- reducing of storage costs,
- increasing of production flexibility,
- increasing of the capacity of production equipment.

Quantity of goods that is in stock depends on several factors, and one of the most important is the size of the production batch. As the size of the production batch is directly related to the time of tool change, hence the indirect connection of the time of tool change to the quantity of stored goods.

For calculation of the size of batch, as well as for the quantity of stored product (semi-product / final product) KANBAN calculation has been used, and one of key factors in that calculation is the time of tool change, as well as the number of replacements during the day.

During the calculation of the batch size, the influential factors that are taken into consideration are:
Available time of the machine for production during the day, cyclical time of action, the number of tool changes which it is possible to be performed on the machine on which the product that is the subject of the analysis is produced, the duration of tool change.
The batch size (LE) is one of the factors in the calculation of the time required for renewal of one card - lead time (TA), minimum stock that can endure the fluctuation - pool stock (SM), the values of Kanban card= 36 parts (Vk, 1Vk = 1 transport trolley = 36 parts), the request of the buyer per day (CMJ), which is presented by the equation (equation 3):

$$N_k = \frac{((\mathrm{TA+SM})\mathrm{xCMJ})+\mathrm{LE}}{V_k} \tag{3}$$

In the example of one referential number, the number of required Kanban cards is calculated in the following way:

TA = 2 h, SM = 8 h, CMJ = 600 pieces/day = 25 pieces/h, LE = 450 pieces, Vk = 36 pieces

$$N_k = \frac{\left(((2\mathrm{h}+8\mathrm{h})\mathrm{x}25\frac{\mathrm{kom}}{\mathrm{h}}\right)+450}{36\ kom} = 20\ cards \tag{4}$$

Using of the results of the equation 3, i.e. by multiplying the maximum number of Kanban cards required for every single product with the surface required for placing of one kanban unit, one obtains required size of space for placing of every single reference. Of course, in this one should also take care of the information on the method of packing of kanban units in the warehouse (possibility of packing in more), which can significantly influence on the final result.

Speeding up the process of tool change influences on reducing of production batch which also entails reducing of required number of Kanban units in every moment. Table (table 2) shows the relation of old and new value of stock by groups, preoccupied space as well as released capacity for both groups of machines after the application of SMED method in the production plant of the company "Mecaplast".

Table 2: Display of benefit of SMED method application

Group	Old stock value €	Old stock occupation m2	New stock value €	New stock occupation m2	Free capacity h/day
Small mashines (200t - 550t)	*5760*	*85,4*	*2220*	*26,6*	*2,7*
Big mashines (550t - 1300t)	*98880*	*324*	*47064*	*104*	*4,8*

Total freed capital by this action is 55,300 € by reducing of stored quantity, 280 m2 of space that has been used for storage, as well as 2,7h and/or 4,8h of released capacity in both groups of machines per day.

As the part of the production plant is used for the storage of semi-products, it can be concluded that by optimization, i.e. by reducing of preparatory time on all machines, the space that can be used for placing of new production units would be significantly unloaded, and without additional expansion of the existing facility, i.e. additional investments.

4. CONCLUSION

On a practical example in the paper it is shown how the application of Shingo's SMED method can influence very efficiently on very important factors, identified by many authors from the beginning, with a large impact on operating of one system. Some of those factors are the costs of storage, the capacity of equipment, flexibility of production etc.

The importance of this paper also represents the display of successful combining of SMED method with other methods, primarily with statistical analysis, and in order to conduct the experiment as efficiently and economically as possible. As it is shown in the paper, after the statistical confirmation that the group of 11 machines for vertical injection is possible to be divided into only 2 groups, the experiment has been conducted on 2 representative samples, one representative from each of the two populations. The conclusions that have been obtained based on the analysis of the results of representatives are implicated on the entire group, whereby the total number of experiments (11) has been reduced to only 2, which has significantly reduced the duration and cost of the complete analysis.

The difference of application of SMED method shown in this paper and other described SMED methods is that the production plan has been also considered here as an influential factor on the duration of change. It has been explained how imprecise and incompletely defined production plan can influence on the total extension of the time of tool change. In support of this, the way of calculation of Kanban system that has been used in the combination with SMED method is presented so that required needs for quantities, capacities and space be determined more rationally. Also, Kanban gives us the possibility of work without classical production plan with constant batch size, whereby the determination of the end of the production batch is ensured, and thereby of the beginning of the preparation of tool change. The result of that is more efficient SMED.

By the analysis of the results and by the implementation of SMED standard on all machines, the saving has been achieved of 55,000 € in freed goods and 200 m2 of storage space.
As the freed space is within production space, it could be used for placing of 4 new machines, whereby the potential investment in the expansion of the facility in the value of 200,000 € is avoided. This proves that the benefit of the application of SMED method is not insignificant.

The importance of this research is reflected in the fact that all tools that have been shown belong to LEAN philosophy that is increasingly current by the change in business climate in our country, primarily after the arrival of a large number of foreign companies. Owners and managers increasingly look for the concrete solutions and concrete and visible results.

REFERENCES

Alves, A.S., & Tenera, A. (2009, May). Improving SMED in the Automotive Industry: A case study, *POMS 20th Annual conference, Orlando, Florida U.S.A.*

Fogliato, F., Fagundes, P. (2003). Troca rápida de ferramentas: Proposta metodológica e estudo de caso. *Gestão &Produção,* 10 (2) 163-181.

Goubergen, D., & Landeghem, H. (2002). Rules for Integrating Fast Changeover Capabilities into New Equipment design. Belgium: Pergamon.

Harmon, R.L., & Peterson, L.D. (1991). Reinventando a fábrica: conceitos modernos de produtividade aplicados naprática. Rio de Janeiro: Campus.

Hotellin,g H., (1930), British Statistics and Statistics today, *Journal of the American Statistical Association*, 25, 186-190.

Mcintosh, R.I., Culley, S.J. Mileham, A.R., & Owen, G.W. (2007). Changeover improvement: Reinterpreting Shingo's "SMED" methodology. *IEEE Transactions on Engineering Management*, 54(1), 98-111.

Mecaplst procedures, Changeover of Production and Lot sizing, Toll GPE 0097, 11.2010, Mecaplast, Monaco.

Shingo, S. (1989). A Study of the Toyota production system. USA: Productivity Press.

KEY PERFORMANCE INDICATORS AND PRICING STRATEGIES PLANNING IN RETAIL INDUSTRY

Milenko Radonić*[1], Vedrana Đorđević[1], Jasmina Omerbegović-Bijelović[1]
[1]University of Belgrade, Faculty of Organizational Sciences
*Corresponding author, e-mail: milenko.radonic@yahoo.com

Abstract: *Choosing and using key performance indicators is necessary for each part of the economy. Retail market is one of the most dynamic fields in economy, and choosing and analyzing the right indicators could be crucial for decision making. This paper should provide guidelines for choosing adequate key performance indicators in retail industry, but also give a brief overview on the different aspects of interpreting those indicators. Modern retail is mostly focused on two main indicators: Turnover and Gross margin, which are directly affecting profitability of retailers. Mentioned indicators could be analyzed more detailed which is of special meaning for lower levels of management. Turnover and Gross margin are indicators that are the basics for many other indicators – Market share, EBIT/EBITDA/EBITDAR, for vertical and horizontal financial analysis, etc. Based on that fact, there are many factors which are dictating the potential turnover and gross margin. One of the main factors are prices and prices strategies. In retail, there are two main pricing strategies: EDLP (Every Day Low Prices) and Hi-Lo (High-Low). Since turnover could be calculated as quantity multiplied with prices, pricing strategies are in position to define planned level of turnover and gross margin. Managing prices successfully gives a good platform for managing key indicators and decision making.*

Keywords*: retail, turnover, gross margin, key performance indicators, pricing strategies planning*

1. INTRODUCTION

The idea of this paper is to present which indicators are relevant and how to choose them, focusing on the retail industry as one of the biggest industries. Also the idea is to make a differentiation between performance indicators and key performance indicators. Key performance indicators (KPIs) could be defined as points on which companies should pay attention the most, and based on which, companies can make decisions. There is a slight difference between KPI and PI (performance indicator). Key indicators are those indicators, which could help management to make strong decisions that will directly affect (positively) on the business results. On the other hand, performance indicators can also affect business results, but without direct impact on business results (for example: tracking employees satisfaction cannot give exact information, did it increase or decrease EBIT[1]/EBITDA[2], etc.). Based on the different levels of top management, key indicators are mostly tracked, analyzed and controlled by every level of management.

The purpose of the paper is to perceive pricing strategies as one of the important parts of all retail strategies, considering other parts of business and to show their impact on some of the key performance indicators. There are several pricing strategies, but two of them are mostly used. More about pricing strategies can be seen in the point 3 of this paper.

The idea of this paper will be presented, considering theoretical frame of key performance indicators, then the development of the retail industry and the use of key performance industry in retail. Afterword, there will be more about pricing strategies and their effect on key indicators. Generally, this paper should present the link between key indicators and pricing strategies and the way they are used to concept.

2. KEY PEROFORMANCE INDICATORS AND THEIR USE IN MODERN BUSINESS

Key performance indicators (KPIs) could be defined as points on which companies should pay attention the most, and based on which, companies can make decisions. There is a slight difference between KPI and PI (performance indicator). Key indicators are those indicators, which could help management to make strong decisions that will directly affect (positively) on the business results. On the other hand, performance indicators can also affect business results, but without direct impact on business results (for example: tracking employees satisfaction cannot give exact information, did it increase or decrease business results, etc.).

[1] Earnings Before Interest and Taxes
[2] Earnings Before Interest, Taxes, Depresiation and Amortization

The starting point for choosing the right performance indicators is to make a list of indicators which are of interest for the board. Those indicators are mostly considered as key ones. Financial performance indicators are mostly used by the top management to manage the business. On the other hand, non-financial indicators are becoming important as much as financial indicators. A challenge is whether the KPIs currently presented to the board are those that allow them to assess progress against stated strategies, and when reported externally, allow readers to make a similar assessment.

Appropriate selection of indicators that will be used for measuring is of a greatest importance. Process organization of business is necessary to be constituted in order to realize such effective and efficient system or performance measuring via KPI. Process organization also implies customer orientation and necessary flexibility in nowadays condition of global competition (Velimirovic, 2010).

New business conditions where information is the most important resource impose new approaches in measuring performances of organizations, related to traditional performance measurement system which evolved just financial and accounting indicators. One of the newer approaches refer on measuring performances of organizations via KPI. KPI are financial and non- financial measures that organizations use to reveal how successful they were in accomplishing long lasting goals. In order to constitute effective system of performance measurement it is very important to have defined and standardized all processes within the organization (Velimirović D, 2010).

The overriding need is for the KPIs to be relevant to that particular company. Management should explain their choice in the context of the chosen strategies and objectives and provide sufficient detail on measurement methods to allow readers to make comparisons to other companies' choices where they want to (Price Water House Coopers, 2014, pp. 8-11).

However, it is the management's duty to suggest and make a portfolio of indicators which will be measured, tracked, analyzed and which will give a good basis for decision making. Considering business conditions, Kaplan and Norton recommended not to use more than 20 key performance indicators. Hope and Fraser suggested even less than 10 KPIs. Even though, the focus in this paper is on key performance indicators, performance indicators (PIs) and key result indicators (KRIs) are important as well. The 10/80/10 rule could be considered as a good proportion and segmentation of the number of tracked KPI/PI/KRIs[3]. It suggests using about 10 KRIs, up to 80 PIs, and 10 KPIs in an organization. For many organizations 80 PIs will at first appear totally inadequate.

Table 1: 10/80/10 Rule
Source: Permanter D, (2007) *Key performance indicators - Developing, Implementing and Using Winning KPIs,* p. 9

TYPE OF INDICATORS	GUIDANCE
Key result indicators (10)	Give information how have organization done in perspective
Performance indicators (80)	Give information and guidance what to do
Key performance indicators (80)	Give information what to do to increase performance dramatically

Many organizations will probably find tracking only 10 KPIs restrictive and may wish to increase the number of KPIs. That could be acceptable and rational if organization is made up from businesses from different sectors, in which case the 10/80/10 rule can apply to each diverse business. In that point, it is normal to increase KPI rollout (Parmanter D, 2007, pp. 8 - 10).

Retail is one of the most important parts of the global economy. Modification of retail from traditional retail to modern retail (online shopping/shopping with entertainment, etc.) has certainly changed KPIs that are tracked (from simple tracking of turnover, retail is now tracking some more advanced KPIs which will be considered in this paper). According to that fact, it is important to perceive the development of retail industry as well.

3. DEVELOPMENT OF THE RETAIL INDUSTRY AND INNOVATION AS THE INCENTIVE FOR TURNOVER

The retail industry has undergone drastic changes in the 80s of the last century. "Modern trade "and the development of large retail chains which could compete with their low-cost products have made a new standard of retailing. It all started with the sale of goods at predetermined locations where buyers would buy the goods

[3] KRIs (Key Results Indicators) mostly cover a longer period of time than KPIs. They are reviewed on monthly/quarterly cycles (not on a daily/weekly basis as KPIs). Separating KRIs from other measures has a profound impact on reporting, resulting in a separation of performance measures into those impacting governance and those impacting management.

they want at a given time and in a given location. Today, retail centers, beside grocery stores, include many specialized sales facilities - bookstores, boutiques and the others (which could be presented as shop-in-shop[4]).

During the 1980s and 1990s, retail industry started changing to modern-retail, under the influence of new technologies. Mass usage of bar codes and development of the internet has reconstructed the traditional ways of retail. Thus, the primary focus during the 80s and 90s was on inventory management, tracking billing and payment methods. Nowadays, CRM is even more changing the retail industry in the terms of specialized offers and connecting the customers with retailers (Dunković D, 2010).

During the 20th century, loyalty programs created a new sphere of retailing – making special offers and analyzing the needs of a customer in order to keep the existing customers, but also to attract the new ones and increase total turnover. Retailers who are leaders in innovation are moving faster in the terms of earning more, attracting more customers and having higher rates of growth. In the table 1, there is a data of top grocery retailers from 2013th year, according to the net sales.

Walmart is the world's biggest retail chain, considering net sales of 467 billion $, earned in 28 countries worldwide. Such as in every other industry, leading retail chains are dictating the tempo and trend of retail. In the previous past years, there is a trend of quick buying, in the lack of time.

However, online retail is getting more popular, and this kind of retail gives a lot to both – customer and a retailer. To a customer it gives more time to spend free, with the delivery on the wanted address, and to a retailer it gives better chances to operate more successfully with supplies.

Table 2: World greatest grocery retail chains
Source: Delloite, Report 2015: *Global Power of Retailing*, pp. 11-16

Rang	Name	Net sales in mil $ (2013.)	No. of countries	Country of orgin	2008-2013 average rate of growth
1	Walmart Stores Ltd.	476.294	28	America	3,30%
3	Carrefour S.A.	98.688	9	France	7,70%
5	Tesco PLC	98.631	18	Great Britain	2,90%
7	Metro Ag	86.393	32	Germany	-0,90%
14	Groupe Auchan S.A.	62.444	13	France	4,00%
17	Aeon Co. Ltd.	57.968	10	Japan	3,90%
24	Ahold N.V.	43.321	7	Netherlands	4,90%
33	Delhaize Group S.A.	28.037	9	Belgium	2,10%
38	Migros	25.010	3	Switzerland	5,40%
42	Marcadona S.A.	23.954	1	Spain	4,80%
63	Coop Italia	15.211	1	Italy	-0,20%
64	Meijer Inc.	15.000	1	America	1,80%
71	S Group	13,233	5	Finland	6,20%
73	Whole Food Market Inc.	12.917	3	America	10,20%
78	China Resources Enterprise, Limited	12,258	5	China (Hong Kong)	22,40%
222	Agrokor d.d.	4,011	3	Croatia	/
226	Axfood AB	3,989	1	Sweden	2,40%
234	Heiwado Co, Ltd.	3,863	2	Japan	-0,40%
241	SMU S.A.	3,823	2	Chile	29,80%
250	Overwaitea Food Group	3,700	1	Canada	6,50%

As the retail industry is considered one of the most dynamic and fastest growing industries, innovation are essential for the survival and development of the market. Innovation in this industry does not necessarily refer

[4] Shop in shop stores are stores specialized for selling a specific group of goods within bigger shopping markets. For example, in Roda Megamarkets, there are specialized shop-in-shop objects for selling equipment of Basketball Assosiation of Serbia.

only to the technology, a new billing system, the system of price reductions, but can also refer to innovations in marketing campaigns, which is the most common example of innovation in this industry.

So, speaking of innovation, it is important in the terms of overall growth and growth of the turnover of a retailer. Generally, there are two main types of innovation in retail: operational and strategic innovation. Operational innovation is related to operational improvements, while strategic innovation is related to radical changes within the retail network. The purpose of innovation in the retail network is approximation of consumer needs, with critical requirements in terms of quality and price. From the standpoint of the company, the time of implementing some innovation is a key factor, due the dynamic of the retail market.

4. KEY PERFORMANCE INDICATORS IN RETAIL INDUSTRY

There are several indicators, which could be considered as key indicators in retail. One of the most basic key performance indicators is total turnover. Turnover in retail could be defined as the quantity of goods sold to customers, or as a total value of those goods. So, it could be presented as both, quantity and value.

Turnover is an input for many other indicators, such as:

- Market share,
- Margins of cost,
- Result (EBIT/EBITDA/EBITDAR),
- Turnover per (m^2, employee),
- etc.

Turnover as itself is the basics for calculating other indicators. Every position in income statement start with total turnover. Table 2 (below) shows the structure of P&L statement (*Income statement*), with total turnover as starting position.

Table 3: Structure of income statement in retail with total turnover as the starting position

TOTAL TURNOVER
-
VALUE ADDED TAX
SALES REVENUES – DISCOUNTS = NET SALES
-
COGS (COST OF GOODS SOLD)
GROSS MARGIN
-
OTHER INCOMES (RENT, REVENUES FROM DISCOUNTS AND OTHER IN-STORE ACTIVITIES WITH PARTNERS, OTHER INCOMES)
TOTAL NET REVENUES
-
TOTAL COSTS
-
OTHER COSTS
OPERATING RESULT (EBITDA - EARNINGS BEFORE INTEREST, TAX, AMORTIZATION AND DEPRECIATION**)**
+
FINANCIAL REVENUES
-
FINANCIAL COSTS
EBIT (EARNINGS BEFORE INTEREST AND TAX)
EBITDAR (EARNINGS BEFORE INTEREST, TAX, AMORTIZATION, DEPRECIATION AND RENT)

Both, turnover and gross margin are contributing to the profitability of a company. However, turnover with low margin rates is not enough for a sustainable profitability. On the picture bellow (Figure 2), it is explained how turnover and gross margin are connected.

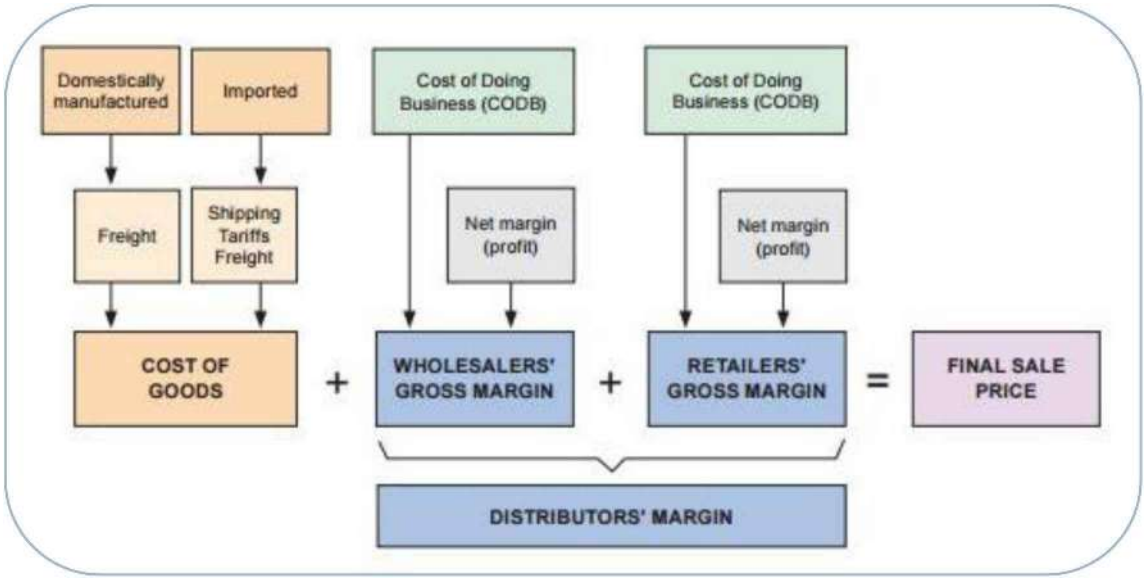


Figure 1: Price calculation structure
Source: D'Arcy P, Norman D, Shan S, *Costs and Margin in the Retail Chain* (2012), p. 15

Price sales is calculated as a cost of goods sold, plus net margin and cost of doing business (which is not necessarily included into final sale price). On the picture above, gross margin form wholesalers is also included, since this model includes wholesaler as one part of the supply chain.

Cost of goods sold can also be reviewed and analyzed as KPI. **The Cost of Goods Sold KPI** measures the actual profit margin on products and services by analyzing how costs such as labor or shipping affect your profit margin. This KPI is instrumental in determining the markup percentage for products and can be a key component in a pricing war with your competition. It's important to remember that even if product is flying off the shelves, you still need to make profit on all that product (Klipfolio, 2016).

Price of the goods is directly linked with the turnover of a retailer, so it is of great interest that a company has a competitive prices. Retailers seek for lowest possible costs of goods, and for the highest possible margins. In that case, the price can be highly competitive in comparison to other retailers.

Seeing the income statement, there is a notion that every position which is presented as a business result (EBIT/EBITDA/EBITDAR) is directly linked with total turnover. In theory, sales is mostly considered as starting position in income statement, but, sales comes from the deference between turnover and VAT (Value Added Tax[5]).

As mentioned before, beside total turnover, turnover could be analyzed as **turnover per employee** (which shows the efficiency of workers) and **turnover per m^2 of shopping space** (which shows the efficiency of used space and it is mostly compared to the cost of rent if that space is not the property of the company).

Total turnover per m^2 (or as it is also called – *Sales per Square Foot*) could be calculated as total net sales divided by net floor space. Net floor space includes only the shopping space (without warehouse and offices if they are integrated within shopping space).

In Table 3, there is a scenario analysis of decision making based on average grocery stores of two biggest retail chains in Serbia: Mercator-S and Delhaize Serbia (considering indicators for three month period including different banners[6]).

On the other hand, turnover per employee is calculated as a quotient between total net sales and FTE (*Full Time Employees*) for a specific grocery store. Top retailers in Serbia, such as Mercator-S and Delhaize Serbia, have the share of rent costs in total turnover 4-5%, which is considered as normal share on this market. For bigger market shops, this percentage could go a little bit higher.

[5] In the Republic of Serbia, VAT has two tax rates: 20% and 10%.
[6] Banners in modern retail include different brands of grocery stores. For example, Mercator-S consists of two banners – Idea and Roda, and both of them include different formats (Small Idea stores, Super Idea, Hypermarkets, etc.). Idea stands for neighbor stores, while Roda has a perception of a family stores, so the banners are percept differently among customers.

Table 4: Turnover per m^2 / Rent costs per m^2

Name of the shop	m^2	Total turnover in RSD	Turnover per m^2 in RSD	Rent costs in RSD per m^2	% Rent costs per m^2	Opinion
Retail shop 1	592	**30.204.000**	**51.020**	**8.300**	**16.26%**	Retail shop 1 is in comparison to other two shops the worst. Margin of renting costs is 16.26% which is above the average % of rent. This shop is ineffective, considering turnover and rent per m^2.
Retail shop 2	1401	**132.308.000**	**94.438**	**4.583**	**4.85%**	Retail shop 2 is the best in balance between renting costs and turnover with 4.85% of share in turnover per m^2. The space of 1401 m^2 is efficiently used.
Retail shop 3	8924	**802.270.000**	**89.870**	**5.350**	**5.95%**	Retail shop 3 has the biggest quadrature, but still it has a relative good balance between rent cost and turnover per m^2.

According to analysis in Table 4, retail shop no. 2 is the most efficient in doing business, while retail shop no. 1 is the worst.

Table 5: Turnover per employee

Name of the shop	No. of employees	Total turnover in RSD	Turnover per employee	Average salary in RSD	% Earning costs in turnover	Opinion
Retail shop 1	14	**30.204.000**	**2.157.428**	**269.333**	**12.48%**	Normal share of salary costs in total turnover are moving in the scale 3-6%. According to that fact, retail shop 1 is not so efficient in the use of the workforce.
Retail shop 2	25	**132.308.000**	**5.292.320**	**292.266**	**5.52%**	Retail shop 2 has a good balance between salary costs and turnover per employee and it is the representative of some bigger supermarkets, such as Idea Super or Maxi stores in Serbia.
Retail shop 3	85	**802.270.000**	**8.438.470**	**235.262**	**2.78%**	Retail shop no. 3 is the most efficient with the 2.78% share of salary costs in total turnover. However, shops that size and with lot of employees, have other costs higher, so in the Republic of Serbia, but also in Europe and America, there is a new trend of quick buying.

Indicators such as turnover per m^2 or per employee are important for middle and lower parts of management in retail, so they are also considered as key performance indicators, based on which, management can make appropriate decisions.

5. THE IMPACT OF PRICING STRATEGIES ON TURNOVER AND GROSS MARGIN INDICATORS

If profit is reviewed as the equation *turnover = price x volume, than, there* are just three turnover drivers: price, volume and costs. Among these components, price is the most effective profit driver.

Profitability is a very important group of indicators in every industry, in retail especially. Without a profitable category of goods and grocery stores, modern retail couldn't exist. Speaking of grocery retailers, with a very low margins, profitability is crucial. Falling into price-promotion traps is hard to manage with both customers and competitors, affecting the terms on the retail market.

During the last few years, price wars has increased the impact on profitability of grocery retailers and has become more fatal for new retailers who enter the market. In the terms of dynamic market, it is really important for a retailer to have a successful and profitable pricing strategies.

There are many pricing strategies, but two of them are mostly used in retail. The first strategy is called "Every Day Low Price" (EDLP) which considers the lowest prices every day for their customers. This strategies is mostly focused on some specific group of products in order to differentiate retailer from its competitors. Wal-Mart is considered as pioneer of the EDLP pricing strategy. It started being popular in the 1990's, but today it is still one of the mostly used pricing strategies.

On the other hand, there is a "High-Low" (Hi-Lo) pricing strategy whereby the retailers set their prices on a higher every day level, but use price discounts and promotions to attract customers.

Researches has shown that the main motivation for using EDLP pricing strategies is cutting down advertising costs and reducing labor as a consequence of cutting back on promotions, but also improving inventory management. Speaking of Hi-Low pricing strategy, it is suggested that the motivation for retailers to use this strategy is to "generate excitement, attract shoppers, clear out time-sensitive merchandise and sell complementary, high-martin items (Voss and Seiders 2003, p. 37).

In theory, using just one pricing strategy doesn't function. Retailers not only use either a Hi-Lo or an EDLP pricing strategy, but follow a "hybrid" pricing strategy containing elements of both Hi-Lo and EDLP. For example, in the German retail market, Rewe is seen as a Hi-Lo retailer, but Rewe also has EDLP elements with its private label brands. On the other hand, for example Aldi and the drugstore chain DM are pursuing an EDLP strategy, but also offer some products on promotion.

An increase in price – holding the volume constant – has a 100% impact on profit, whereas an increase in volume – holding the price constant – just influences the profit to the amount of the additional turnover minus the marginal costs (Husseini, 2015).

Nowadays, there are several methods by which a pricing strategy could be presented to a customers. The mostly used method is loyalty program method. Running a loyalty programs is a huge managerial task. Affecting on the customer perception of loyalty program – coupons, loyalty cards, bonus points, etc. are just the top of the iceberg. Behind that, there are many activities – logistics activities, involving and card issuing, call centers, involving card issuing, negotiation with partners in the scheme and suppliers of bonus merchandise, and so on (Stone, 2004, p. 308).

Tracking the competitor's activities through usage of pricing strategies can be done using different models and methods. One of them is the competitive matrix for pricing strategies (Table 5).

Table 6: Price index matrix - pricing strategies
Source: Blazek A, Deyhle A, Eiselmayer K. (2011), Controlling System, p. 114

Factors	Weight	Scale					Total
		1	2	3	4	5	
In-Store pleasantness	30%					x	150
Online shop	5%			x			15
Assortment	30%				x		120
Loyalty programs	5%				x		20
Time spend queuing	30%		x				60
Total	**100%**						**365**

The matrix consists of factors whose importance is determined by the sum of weighting to give 100%. It also contains the scale of 1-5, which is estimated ratio compared to competitor (1- much worse, 2 - worse, 3 - the same, 4 - better 5 - much better). Multiplying the scale of weights we get the total amount. The competitor automatically has a total amount of 300 (by multiplying the sum of all weights - 100 with the number 3).

Comparing the ratio obtained by our company and the number 300, we get a percentage which shows should the company increase or decrease the prices in comparison to the main competitor. If that ratio is higher than 1, than the company has the potential to increase the prices of its goods, and in opposite, to decrease prices.

For the analysis of the factors and assessing whether the factor determined by the company is better than a competitor, it is necessary to do more detailed quantitative analysis, and even seek the help of consultants and research agencies. If we compare company X with company Y – main competitor, on the given example in table above, the calculation has given the sum for company X of 365. If that amount is divided with 300 (competitors score), the comparing ratio is the number 1,215. That means that for the company X it is justified to increase prices by 21.5%.

6. CONCLUSION

Managing key performance indicators is crucial for all retailers. There are two main types of indicators which are mostly used in every business. Key performance indicators (KPI's) doesn't necessarily have to include only financial indicators (sales, EBIT, EBITDA, etc.), but could also include some non-financial indicators as well. Choosing the proper indicators is crucial for every business. But, it is important to put the accent on the different aspects of reviewing selected indicators. Top management and other lower parts of management doesn't consider every KPI with the same importance. Turnover and gross margin are two basic indicators in grocery retail. They are tracked by every level of management, but there are some more specialized indicators such as sales per square foot or turnover per employee which are more interested to lower levels of management (for example managers of grocery stores) than to the top management. With low margin levels, grocery retailers must establish higher turnovers in order to have a profit and to do business with a certain level of sustainability. However, there are several factors directly affecting on gross margin and total turnover. Two of them are prices and the quantity of goods sold. Speaking of prices, grocery retailers are mostly using two pricing strategies: EDLP (*Every Day Low Prices*) and Hi Lo (*High-Low*). Nowadays, retailers use hybrid pricing strategies – combining both mentioned pricing strategies with a planned combination for different groups of goods. It is up to category managers to plan those strategies carefully and to track changes on the retail market in order to establish target. Having a strong and consistent pricing strategies will provide to a retailer a competitive advantage on the long terms. All in all, with the proper analysis, use of key performance indicators and proper mix with adequate pricing strategies, retail chains can run toward leading positions on the retail market. Customers are mostly attracted by location of the grocery store and by the kindness of employees (GfK Market Research, 2015). Considering that fact, there is still enough space for additional research of turnover, and the impact of employee's satisfaction and efficiency of selling space on total turnover.

REFERENCES

Blazek A, Deyhle A, Eiselmayer K. (2011), *Controlling System*, Controller Akademie

D'Arcy P, Norman D, Shan S. (2012), Chain, Costs and Margins in the Retail Supply, Vol. 6,13-22. *Bulletin*

GfK (2015), Retail market research for 2015, GfK Agency for market research

Klipfolio. (2016, march 26), Klipfolio - KPI in Retail. Retrieved from https://www.klipfolio.com/resources/kpi-examples/retail/cost-of-goods-sold Klipfolio. (2016, march 26)

Parmanter D, (2007) *Key performance indicators - Developing, Implementing and Using Winning KPIs*, John Wiley & Sons Inc., 8-10.

Stone M, Bearman D, Butscher S. A, Gilbert D, Crick P (2004). The Effect of Retail Customer Loyalty Schemes. *Journal of Targeting, Measurement & Analysis for Marketing*, Vol. 12, issue 3, 305-318.

Unknown author (2014), *Guide to Key Performance Indicators*, 8-11. Price Water House Coopers.

Unknown author (2015), *Report 2015: Global Power of Retailing,* 11-16. Delloite

Voss G., Seiders K. (2003), Exploring the Effect of Retail Sector and Firm Characteristics on Price Promotion Activity, *Journal of Retailing*, 37-52. Sloan Management Review

Velimirović D, Velimirović M, Stanković R. (2010). Role and importance of key performance indicators measurement, *Sserbian Journal of Management*, Vol. 6, 63-65.

OPEN SOURCE ENTERPRISE RESOURCE PLANNING: SOLUTION FOR PRODUCTION PLANNING IN SMEs

Zoran Rakićević*[1], Jasmina Omerbegović-Bijelović[1], Danica Lečić-Cvetković[1]
[1]Faculty of Organisational Sciences, University of Belgrade
*Corresponding author, e-mail: zoran.rakicevic@fon.bg.ac.rs

Abstract: *This paper presents the study on open source Enterprise Resource Planning (ERP) software from the perspective of their production module. The study was based on the survey of five open source ERP software. The survey method was content analysis. The observed ERP solutions were evaluated, in a qualitative way, regarding important functionalities and analysis tools of their production module. Besides that, the paper is also focused on capabilities, advantages, and shortcomings of open source ERP solutions for small and medium-sized enterprises. The purpose of this paper is to further present information and knowledge about reasons for SMEs to adopt open source ERP. One of the goals is also to promote alternative ways of supplying SMEs with adequate management and IT solutions. In this paper, analysed and presented open source ERPs (Oddo, WebErp, OpenBravo, Compiere, and NextERP) have proved to be very useful and equipped solutions for SMEs production planning. The findings of this paper are interesting both for scholars and practitioners (including SMEs) as well as for ERP developers.*

Keywords*: Enterprise resource planning (ERP), small and medium-sized enterprises (SMEs), production planning, open source ERP*

1. INTRODUCTION

Contemporary planning and management cannot be imagined without the usage of information and communication technology (ICT). According to the American Production and Inventory Control Society - APICS (Cox & Blackstone, 2005), Enterprise resource planning (ERP) is defined as a „*method for the effective planning and controlling of all resources needed to take, make, ship and account for customer orders in a manufacturing, distribution or service organization*". ERPs are often defined as standardized packaged software designed to integrate an organisation's entire value chain (Johansson & Sudzina, 2008). According to Heizer and Render (2011), Enterprise Resource Planning is software that allows companies to: (1) automate and integrate many of their business processes through planning of enterprises resources; (2) share a common database and business practices throughout the enterprise; (3) produce information in a real time. At the strategic level, ERP system presents an application programme that integrates all business functions and processes (Loh & Koh, 2004). At the operational level, ERP is the system for planning and monitoring resources of manufacturing, i.e. manufacturing resource planning system (Loh & Koh, 2004).

The roots of ERP system originated in the manufacturing industry in the 1980s, through the development of Materials Requirement Planning (MRP) method and Manufacturing Resource Planning (MRP II) concept (Kilic et al., 2015). Later it evolves in the integral information system with different modules for resource planning and management of production, service and commerce. The core modules included in ERP are (Zhang et al., 2005; Madanhire & Mbohwa, 2016): *Production planning* module with the primary purpose to optimize the utilization of manufacturing capacity and material resources using historical production data and sales forecasting; *Purchasing module* facilitates procurement of required raw materials, and automates the process of placing orders to suppliers; *Inventory control module* enhance the process of maintaining appropriate stock level and identifying inventory requirements; *Sales module* helps in order placement and scheduling, shipping and invoicing; *Marketing module supports* marketing activity and campaign; *Financial module,* as the core module, collect and integrate financial data from every department and generate financial reports and statements; *Human resources module* retains a complete database with information about employees. Thus, ERP software system is a comprehensive system which consolidates all departments from purchasing via production to distribution in one integrated system and manages it (Madanhire & Mbohwa, 2016). Furthermore, according to Ruivo, Oliveira, and Neto (2015), ERP system provides process-oriented business management view which is more effective and organised

way of executing business operations then the functions-oriented. So, one of the main advantages generated by the implementation of the ERP system is integration between enterprise's departments and processes throughout the ERP modules, with achieving different operational performances such as: improved productivity, lowered costs, more reliable performances, reduced paperwork, and saved time (Antoniadis, Tsiakiris, & Tsopogloy, 2015). In the last ten years, besides the conventional ERP systems, the focus is on the open source, cloud and mobile ERP systems, especially their application in small and medium-sized enterprises (SMEs). A comprehensive literature review in ERP field is presented in Huang & Yasuda (2016).

The development of ERP for SMEs rose from two sources: the first is the business needs of SMEs, which become more complex in global business and supply chain environment; and the second is saturation of large companies' market demand. In that situation, ERP producers introduce solutions for small business. Corresponding to Ruivo, Oliveira & Neto (2015) the most literature studies are about ERP comparisons regarding the selection process and, implementation duration and costs. However, little studies examined ERP implementation in SMEs and even less described the comparison of different ERP products. Besides that, Huang and Yasuda (2016) deduced that research on SMEs and ERP will continuously increase, mainly because many new ERP producers provide different solutions that can be easily implemented and maintained by SMEs. Several years before, Johansson and Sudzina (2008) stated that there is tremendous interest in free and open source ERP systems. Due to previous, the authors of this paper consider Open Source ERP in the context of SMEs as a very actual research topic.

In this paper, we will analyse and compare five Open Source ERPs software observing their production planning module. Our main research question was: Are the Open Source ERPs software appropriate for SMEs? The rest of the paper is organised as follows: Section 2 introduces the concept of production planning. Section 3 describes ERP through SMEs point of view. Section 4 presents the qualitative evaluation of observed software concerning their production module. Section 5 concludes the paper.

2. ENTERPRISE PRODUCTION PLANNING

Planning as a management phase includes defining the objectives, as well as activities and resources which are necessary for achieving the proposed objectives, taking into account all constraints (Omerbegović-Bijelović, 2006, p. 36). Broadly observed in business operations of every enterprise, planning is concerned with the adjustment between what the market requires and what the operation's resources can deliver (Slack, Chambers, & Johnston, 2007, p. 290). The domain of production and service planning are the defined goals and activities which are conducted with appropriate resource usage, in order to obtain efficient and effective production and servicing process.

The process of operations planning (production and service delivery) initially start from the demand forecasting of product and services. On the basis of anticipated demand, long-term needs for capacities of production and service provision are planned. Long-term capacity planning decisions are a framework for planning capacity and demand on mid-term – which is the information input in the process of aggregate planning. Aggregate planning includes defining the strategy on a mid-term (3 to 18 months) for engagement of human resources, production capacities, quantities of different categories of product and services, inventories, overtime work and subcontracting, all with the aim of cost minimization. After aggregate planning, next phase is master production scheduling. Master Production Schedule (MPS) defines planned quantities of different product and service varieties in planned time for its realisation. MSP is the result of aggregate plan decomposition. MPS together with bill of material present the basis for the next phases of production planning: *Material Requirements Planning (MRP),* negotiating and selections of suppliers, contracting of supplies, raw material and components ordering, time scheduling of production activities on different machines and workers, production orders launching, dispatching material in the production process (Omerbegović-Bijelović, 2010). Presented concept of production planning doesn't have to refer to only one company. The modern trend in management involves the orientation on the networks of production and service enterprises which are in customer to supplier relation, known as supply chain or value chain (Omerbegović-Bijelović, Atanasov & Rakićević, 2014). The task of planning is more complicated at enterprises that are in the supply chain because it is necessary to define plan for all of the enterprises which are connected to each other.

According to the authors (Schut, 2004, p. 219; Gansterer, 2015), production planning (including whole Supply Chain) covers the following areas: Sales forecasting, quantitative support for sales and operations planning, integrated supply chain tactical planning, production requirements calculation from distribution network requirements, master production scheduling, detailed scheduling of production, inventory deployment planning in a distribution network and short-range transportation planning.

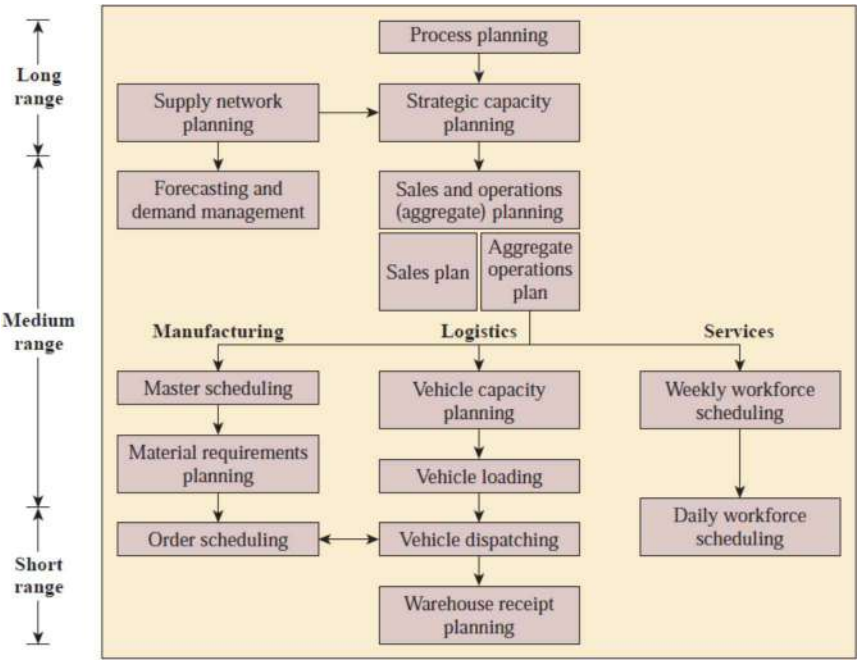


Figure 1: Main activities in planning of production and servicing operations
Source: Jacobs & Chase (2010, p. 286)

Junior & Filho (2012) in their paper defined next production planning activities: product demand forecast, aggregate planning, determining of the master production schedule, inventories planning, capacities planning, determining production order quantities, scheduling of production activities.

3. SMALL AND MEDIUM-SIZED ENTERPRISES AND ENTERPRISE RESOURCE PLANNING

Surveys and studies relating to the implementation of enterprise resource planning (ERP) systems in small and medium-sized enterprises (SMEs) has been rapidly increasing in recent years (Loh & Koh, 2004). Mabert et al. (2003), presented the difference between large and small and medium-sized enterprises in their implementation of ERP software. They approved that large companies customize ERP software more often while small enterprises adopt business processes within ERP systems. Besides that, large companies reported greater benefits in the financial areas, while small companies report more benefits in manufacturing from their ERP implementations. SMEs, which are in a supply chain, that deals with large enterprises and have an ERP system with production planning module will provide better performances in manufacturing, like *productivity*, *customer services*, *inventory turns* and *reduction in material cost* (Mabert et al. 2003; Loh & Koh, 2004).

Antoniadis, Tsiakiris & Tsopogloy (2015), in their survey based on respondents' opinions, identified the following key benefits of ERP utilization in the SMEs: data integration from different departments, reliability of information, saving time by automating procedures, controlling activities and flexible decision making. However, the cost reduction was the less important advantage of implementing the ERP system in the company, despite the fact that during crisis periods, reducing cost is essence for SMEs. The same authors present the main disadvantages and deterrents for ERP systems adoption: cost of initial setup and support and, the cost and time required for training the personnel to handle the new ERP system. Ruivo, Oliveira & Neto (2015), also defined benefits of using ERPs: ERP systems allow information to flow transparently in a firm's ecosystem, benefiting its supply chain efficiency; ERP systems can bring operational excellence and competitive advantages to firms.

Obvious benefits of ERP software can be achieved if its implementation was successful. Antoniadis, Tsiakiris & Tsopogloy (2015) presented the most important factors for successful implementation of ERP in SMEs: Appropriate ERP provider support, ERP customization and parameterization, ability of communication and cooperation between all the involved enterprise departments, personnel's training and education, level of quality service in external technical support for the ERP. Beside this, in comprehensive analysis Upadhyay et al. (2010), identified several critical factors: 1) Education and training to enhance SMEs employees knowledge and proficiency; 2) Clearly defined goal and scope of ERP implementation; 3) Top management support through providing necessary resources and providing leadership; 4) Proper project planning due to constrained SMEs' resources; 5) Minimal customization (fit the organisational needs to the functionality of ERP); 6) Proper implementation strategy ("Big bang" or "vanilla" approach).

Resource constraints of small business are huge obstacle for purchasing of ERP system. One of the possible options for SMEs is to implement Open Source ERP software. Johansson and Sudzina (2008) presented initial literature review about open source ERP and SMEs. They also identified the lack of studies about why SMEs choose open source ERPs instead of proprietary ERPs and try to bridge it within their survey.

The SMEs present backbone of the Serbian and European economy. Every study about improving SMEs' competitive advantages as well as their further development has vital importance. Adoption of ERP system is one of the most important technological and organizational innovations in modern SMEs, since it promotes knowledge diffusion, and accelerates their business decision-making processes. Therefore, a good consideration and multi-criteria analysis should be applied in a selection process (Kilic et al., 2015).

4. COMPARATION OF THE OPEN SOURCE ERP SOLUTIONS

Before the comparison among Open Source ERPs will be presented, it is necessary to remark that three best-known ERP vendors (SAP, Oracle, and Microsoft Dynamic) take about 55% of the market share. The commercial prices of mention proprietary ERP solutions are among 5.000 up to 250.000 $. (Top ten ERP vendors in 2016, https://www.top10erp.org). The result of this fact is that SMEs, especially those that are micro and small, can't afford proprietary ERPs, and they turn to open source solutions.

The term "open source" refers to something that can be modified and shared because its design is publicly accessible (https://opensource.com/resources/what-open-source). While it originated in the context of computer software development, today the term "open source" designates a set of values - what we call *the open source way*. Open source projects, products, or initiatives are those that embrace and celebrate open exchange, collaborative participation, rapid prototyping, transparency, meritocracy, and community development. Open source software is software which source code is available for modification or enhancement by anyone. Open source software is partially free and comes with the open source code that has possibilities to be adjusted and changed according to users' needs (Riehle, 2007). Sometimes open source software licenses provide users possibilities to redistribute the software.

There are two types of open source software: *Community open source* is software where broad community of volunteers are developers; *Commercial open source* is software that a for-profit entity owns and develops. The owner company maintains the copyright policy and determines what can be changed and implemented in software code (Riehle, 2007). Commercial open source software is usually available for free to non-profit users. Sometimes, for commercial users, it is free as well. In that situation companies make money by providing support services and selling software upgrades. Really interesting businesses are companies and individuals (known as committers) that provide IT services for different open source software.

Even though that open source software are initially free, they could have cost related to the usage (cost of learning, cost of adjustment and cost of maintenance). The main implementation problem of ERP software, both proprietary or those that are open source, is unsuitability between ERP functionality and company requirements (Johansson & Sudzina, 2008). Project of ERP implementation requests that organization changes processes or adjusted ERP solution according to them. However, in the case of process changes, one of the big advantages for SMEs is their small scale and,

consequently, flexibility and adaptability. Besides that, in the case of ERP customization, the great characteristics of open source solutions is that they present: process delivery model (that can be implemented) and, development model that need to be tailored.

Decision process for implementation open source ERP in SME may include the evaluation of different ERP characteristics: usability, compatibility, features, support cost and, software reliability (Johansson & Sudzina, 2008). Kilic et al. (2015) defined three groups of evaluation criteria: Business criteria (brand image and market position), Cost criteria (purchasing cost, implementation cost, and support cost) and technical criteria (functionality, reliability, compatibility). Business criteria are brand image and market position; cost criteria are purchasing cost, implementation cost and support cost; while technical criteria are functionality, reliability and, compatibility.

In analysis, which will be presented underneath (Table 1), ERPs' production module features will be observed. First, every analysed open source ERP (Odoo, WebERP, OpenBravo, Compiere and ERPNext) will be described in a few sentences.

Odoo ERP (previously titled TinyERP) is partially free open source ERP for all size-companies. For two users when the system is hosted online, it is free. For the off-line version intended for larger number of users, it is not. Besides that, Odoo is totally free for in-house maintenance. This software covers all standard modules and functionalities (the application suite includes: billing, accounting, manufacturing, purchasing, warehouse management, and project management) and is perfect for managing small business lower than 50 employees (http://www.odoo.com).

WebERP is an open source ERP system for SMEs. WebERP is a complete web based business management system that requires only a web-browser and .pdf reader to be used. It has a wide range of modules and features suitable for many businesses particularly distributed businesses in wholesale, distribution and manufacturing. Due to its on-line hosted nature, it is less hardware demanding than others off-line solutions (http://www.weberp.org).

OpenBravo ERP is a commercial on-line ERP based on a modular system for small and medium-sized companies. The software comes in three editions depending on the needs of particular organization. OpenBravo Community Edition is the free of charge that offers reduced functionalities in compare to payable versions (Enterprise and Professional edition). These editions include some premium, commercial modules — like financial management and inventory management — that many businesses find necessary. This program is among the top ten most active projects on *SourceForge* - centralized Web-based service for control and management of free and open-source software projects (http://www.openbravo.com/).

Compiere is the open source and cloud-ready ERP solution for SMEs in distribution, retail, manufacturing and service industries. Compiere automates accounting, supply chain, inventory and sales orders. It is one of the successful open source projects with more than 1.8 million downloads till nowadays. Compiere includes wide range of modules and encourages enterprises to customize and match Compiere towards they business needs (http://www.compiere.com/).

ERPNext is the on-line open source ERP solution designed for small and medium businesses and is presented as a series of applications. ERPNext covers many business functions including accounting, inventory management, Customer Relationship Management (CRM), purchasing, project and task management, human resource management and manufacturing. ERPNext is very easy to set up, using simple forms to enter information about business in typical setup wizard style. This solution very quickly becomes familiar as the ERPNext is very user-friendly (https://erpnext.com/).

Table 1 shows evaluation of observed open source ERP solutions from perspective of their manufacturing module with contained production planning tools: Manufacturing order, Bill of material, Production costs, Order planning, Aggregate planning, Master production schedule, Gantt chart planning, Quality control planning and reports, MRP (Material requirements planning), Sales and production forecasting, Traceability of products, Product manufacturing routings, Inventory management (receipts, internal transfers, delivery orders), Automated purchase orders, ABC inventory analysis, Inventory algorithms, Production scheduling, Production and inventory reports, Capacity requirements planning, Product lifecycle management, Maintenance planning. Besides that, we examine: ERP solutions' connectivity with other applications and programs; whether solution is

available for online/cloud usage; is there option for multilingual customization (particularly for the Serbian language); what is the initial price in the form of licence fee for obtaining observed ERP solutions.

Table 1: The evaluation of Open source ERP solutions

Tools of manufacturing module:	Open source ERP solutions				
	odoo	webERP	openbravo	Compiere	ERPNext
Manufacturing order	✓	✓	✓	✓	✓
Bill of material	✓	✓	✓	✓	✓
Production costs	✓	✓	✓	✓	✓
Order planning	✓	✓	✓	✓	✓
Aggregate planning	x	x	x	x	x
Master production schedule	✓	✓	✓	✓	x
Gantt chart	✓	x	x	x	✓
Quality control planning	✓	✓	x	x	✓
MRP	✓	✓	✓	✓	✓
Sales & Prod. forecasting	✓	✓	✓	✓	x
Traceability of products	✓	x	x	✓	✓
Product manufacturing routings	✓	x	x	✓	x
Inventory management	✓	✓	✓	✓	✓
Automated purchase orders	✓	✓	✓	✓	✓
ABC inventory analysis	x	x	✓	✓	x
Inventory algorithms	x	x	✓	x	x
Production scheduling	x	x	x	✓	x
Prod. & inventory reports	✓	✓	✓	✓	x
Capacity requirements planning	x	x	x	✓	✓
Product lifecycle management	x	x	x	x	x
Maintenance planning	x	✓	✓	x	✓
Manufacturing type	Discrete	Discrete	Discrete	Discrete	Discrete
Connectivity	CSV/XLS/ XML/ODS	PHP/ CSV	XML	CSV/XML/XLS DOC/PDF	CSV/XLS
On-line/cloud	✓	✓	✓	✓	✓
Multilingual	✓	✓	✓	✓	✓
The Serbian language	✓	x	x	x	x
Licence fee	240$ per user per year	0$	4.500$ for professional edition	0$	300$ per user per year

According to the analysis in Table 1, all solutions are well equipped. Although presented solutions are generally among each other's, still some solutions that dominate in particular features:

- Aggregate planning is not possible with observed ERPs;
- Planning with Gantt chart is present in Odoo and ERPNext;
- Quality control planning are available in Odoo, WebERP, and ERPNext;
- Sales and production forecasting are part of all observed open source solutions, except for ErpNext;
- Traceability of products is available in Odoo, Compiere and ERPNext;
- Manufacturing routings are available in Odoo and Compiere;
- ABC inventory analysis is only present in OpenBravo and Compiere;
- Inventory algorithms are only present in OpenBravo;
- Production scheduling is part of Compiere, though advanced production scheduling and optimization in not part of any observed software in Table 1. This functionality is still unreachable for this softwares;
- Capacity requirements planning is available in Compiere and ERPNext;
- Product lifecycle management is unavailable in all observed solutions;
- Maintenance planning is included in WebERP, OpenBravo and ERPNext;
- All analysed open source ERPs are intended for discrete type of manufacturing;
- Comprehensive ability for connection with other software and platforms have Odoo and Compiere (CSV/XLS/XML/ODS/PDF);
- Every observed ERPs are available in on-line/cloud version;

- Language of platform: all software are multilingual. The Serbian language is only available for Odoo;
- Licence fee: WebErp and Compiere are free of licence cost.

Although every analysed software has one or more omitted tools and features for production planning, the authors of this paper believe that they are excellent and very economical choice for SMEs. This attitude is also strengthened with fact that open source ERPs have possibilities for adjustment and upgrade in accordance with their open source code.

5. CONCLUSION

The study presented in this paper aimed at investigating the capabilities of production module of open source ERP software for small and medium-sized enterprises. The analysed sample was consisted of five open source ERP solutions, which were compared with set of common features of their production module. The analysis showed that open source ERP have wide range of possibilities, as well as that there are dominated open source ERP solutions for particular features: a) Zero licence cost (for WebErp and Compiere software); b) Excellent language customization (especially Odoo for the Serbian language); c) Connectivity with other software for data export and import (Odoo and Compiere); d) Modern planning methods and tools: Gantt chart (Odoo and ERPNext), sales and production forecasting (Odoo, WebERP, OpenBravo, and Compiere), traceability of products (Odoo, Compiere, and ERPNext), product manufacturing routes (Odoo and Compiere), ABC inventory analysis (OpenBravo and Compiere), inventory algorithms (OpenBravo), production scheduling (Compiere), capacity requirements planning (Compiere and ERPNext), maintenance planning (WebERP, OpenBravo, and ERPNext);

Open source ERP software present great opportunity for small business due to their initial cost and adaptable nature. Serrano and Sarriegi (2006) stated that benefit of applying open source ERP solutions are greater than for other applications. This is reflected in: 1) Increased adaptability of ERP solutions due to full access to source code; 2) Decrease dependency on single supplier – companies that purchase a proprietary ERP are highly dependent on the software producers or distributors; and 3) Reduced costs – open source ERP usually avoid licence costs, and if the consultant charge for customization is not high it will result in lower cost of implementation.

The results of this study can be used for the practical and theoretical purpose. Regarding the practical, implications it can be useful for owners and managers of SMEs to support a technological and organizational development of their small businesses. Theoretical implications are reflected in knowledge contribution to scientific fields of production planning and management of SMEs. Further research will be focus on detailed analysis of the wider group of open source ERPs as well as surveys of SMEs, their management problems and detail needs for ERPs implementation.

REFERENCES

Antoniadis, I., Tsiakiris, T., & Tsopogloy, S. (2015). Business Intelligence during times of crisis: Adoption and usage of ERP systems by SMEs. *Procedia - Social and Behavioral Sciences,* 175, 299-307.

Cox, J. F., Blackstone, J. H., (2005). *American Production and Inventory Control Society* (APICS) Dictionary – 11th edition. Amer Production & Inventory, USA.

Gansterer, M. (2015). Aggregate planning and forecasting in make-to-order production systems. *International Journal of Production Economics*. An article in press.

Heizer, J., Render, B., *Operations Management*, 10th edition. Pearson, Prentice Hall, New Jersey, 2011.

Huang, T., & Yasuda, K. (2016). Comprehensive review of literature survey articles on ERP. *Business Process Management Journal*, 22(1), 2-32.

Jacobs, F. R., & Chase, R. B. (2008). *Operations and supply management*: The core. New York, NY: McGraw-Hill Irwin.

Johansson, B., & Sudzina, F. (2008). ERP systems and open source: an initial review and some implications for SMEs. *Journal of Enterprise Information Management*, *21*(6), 649-658.

Junior, M. L., & Filho, M. G. (2012). Production planning and control for remanufacturing: literature review and analysis. *Production Planning & Control*, 23(6), 419-435.

Kilic, H. S., Zaim, S., & Delen, D. (2015). Selecting "The Best" ERP system for SMEs using a combination of ANP and PROMETHEE methods. *Expert Systems with Applications*, *42*(5), 2343-2352.

Loh, T. C., & Koh, S. C. L. (2004). Critical elements for a successful enterprise resource planning implementation in small and medium-sized enterprises. *International Journal of Production Research*, 42(17), 3433-3455.

Mabert, V. A., Soni, A., & Venkataramanan, M. A. (2003). The impact of organization size on enterprise resource planning (ERP) implementations in the US manufacturing sector. *Omega*, *31*(3), 235-246.

Madanhire, I., & Mbohwa, C. (2016). Enterprise Resource Planning (ERP) in Improving Operational Efficiency: Case Study. *Procedia CIRP*, 40, 225-229.

Omerbegović-Bijelović, J. (2006). *Planning and preparation of production and servicing* (in the Serbian language). University of Belgrade, Faculty of Organizational Sciences.

Omerbegović-Bijelović, J. et al. (2010). *Basics of Operation management* (in the Serbian language). University of Belgrade, Faculty of Organisational Sciences.

Omerbegović-Bijelović, J., Atanasov, N., & Rakićević, Z. (2014, Jun). Improvement of the planning system in supply chains and software support. Proceedings of the 14th International Symposium SymOrg, 1239-1249. Zlatibor, Serbia.

Riehle, D. (2007). The economic motivation of open source software: Stakeholder perspectives. *Computer - IEEE Computer Society*, 40(4), 25-32.

Ruivo, P., Oliveira, T., & Neto, M. (2015). Using resource-based view theory to assess the value of ERP commercial-packages in SMEs. *Computers in Industry*, *73*, 105-116.

Serrano, N., & Sarriegi, J. M. (2006). Open source software ERPs: a new alternative for an old need. *IEEE Software*, *23*(3), 94.

Slack, N., Chambers, S., & Johnston, R. (2007). *Operations management*. Prentice Hall, Pearson Education.

Top ten ERP vendors (2016). Link: https://www.top10erp.org (accessed on 22 April 2016).

Upadhyay, P., Basu, R., Adhikary, R., & Dan, P. K. (2010). A comparative study of issues affecting ERP implementation in large scale and small medium scale enterprises in India: a Pareto approach. *International Journal of Computer Applications*, 8(3), 23-28.

Zhang, Z., Lee, M. K., Huang, P., Zhang, L., & Huang, X. (2005). A framework of ERP systems implementation success in China: An empirical study. *International Journal of Production Economics*, 98(1), 56-80.

GPI PROCESS PERFORMANCE MEASUREMENT MODEL

Barbara Simeunović*[1], Dragoslav Slović[1], Milić Radović[1]
[1]University of Belgrade, Faculty of organizational sciences
*Corresponding author, e-mail: tisma@fon.bg.ac.rs

Abstract: *This paper investigates the possibility of developing flexible process performance measurement model. The results of comparative analysis of existing process performance measurement models suggest that they lack flexibility, ie the ability to use model in a wide and varying range of companies, with no significant changes in the model. New GPI process performance measurement model (in the narrow version) is proposed, that has improved flexibility compared to existing process performance measurement models. Results of case study show that proposed model can create basis for effective performance management, and also for further research in this area.*

Keywords*: process performance measurement, goals, key processes, process performance indicators, flexibility*

1. INTRODUCTION

In order to achieve sustainable performance of business system, it is crucial for companies to manage its processes, and process management requires the continuous measurement of their performances. In the literature, as in practice, there are number of models and frameworks that provide guidelines for the performance measurement system development and review performance measurement problems from different perspectives. Besides tendency to link operations and processes to strategic goals, they integrate financial and non-financial measures, and focus all business activities on customer requirements (Lynch & Cross, 1995, p.6). Nevertheless, these different approaches have led to numerous definitions of a performance measurement system, but still, there is little consensus regarding its main components and characteristics. (Dumond, 1994, p.17).

Since the environment in which the organizations operate is dynamic and success depends upon meeting the changing needs of all stakeholders, it is necessary for organizations to evaluate performance from an external perspective, listening to customers, suppliers and other stakeholders (Striteska & Spickova, 2012, p.1). Also, the organization goals need to be changed over time and when goals change, some performance measures (indicators) must be changed too. According to Franceschini et al. (2007, p.55), one of the most critical aspects in operations management is “translating” a company’s goals into performance indicators.

Nowadays, there are a number of performance measurement (PM) models that include or strongly rely on performance planning, job design, performance measures determination and monitoring, and on the reward system definition (Sikavica & Hernaus, 2011, p.433). Those frameworks assist in this performance measurement system building process by clarifying boundaries, specifying dimensions or views and may also provide initial intuitions into relationships among the performance dimensions (Rouse & Putterill, 2003, p.792). Various PM models consider performance from different perspectives, and they are designed for different purposes. Majority of them takes into account the strategy or goals while determining performance, but none of analysed models link directly organizational goals and performance indicators, in other words, they don’t specify their interdependence, which would allow model flexibility. There is, therefore a need for improving the flexibility in the performance measurement models.

The development of PM model, that starts from the strategic objectives defined in accordance with the stakeholders' requirements, and translates them on the goals of lower hierarchical levels, and then connects them with key performance indicators processes (which realize defined objectives), will allow the connection of strategic objectives and key process performance indicators. By this, the flexibility of the model, ie its simple and easy applicability in the various organizations, can be increased.

In the paper, after the brief literature review about process performance indicators and PM models, research hypothesis is proposed. After that, the methodology of research is described. Then, the initial model was proposed, and the case study research was described. Based on the study findings, previously

conceptualized model is improved. At the end, some conclusions are drawn, as well as the directions of future research.

2. LITERATURE REVIEW AND HYPOTHESES

2.1. Process performance indicators

A process performance indicator is a measure that reflects the critical success factors of a business process defined within an organisation, in which its target value reflects the objectives pursued by the organisation with that business process (Del-Río-Ortega, Resinas & Ruiz-Cortés, 2010, p. 555). Key performance indicators (KPIs) provide a valuable source for the translation of strategic objectives to process-specific goals and facilitate effective process control (Rosemann & vom Brocke, 2010, p.115).

Although most authors agree that the performance indicators have to be linked to the organization's strategy and objectives, there is no unique and universal approach to determining performance indicators. Turajlić et al. (2009) proposed Strategic Alignment Pyramid for ilustration the process of KPI determination. Parmenter (2010) proposed the 12-step model for development and usage of KPIs. Franceschini et al. (2007) sugesst 5-step approach that contributes to improved organization for measurement performnse system development.

Many authors defined the specific lists of performance indicators for certain types of organizations or business areas (Sikavica & Hernaus, 2011; Parmenter, 2010; Supply-Chain Council, 2010; Addison et al, 2009). Besides Parmenter's list (Parmenter, 2010), which can be considered as universal, all other examples of performance indicators' lists are limited to a specific area or performance perspective.

2.2. Process performance measurement models

In the literature, as in practice, there are number of models and frameworks that provide guidelines for the performance measurement system development. The objective for such models is to help organizations to define a set of measures that reflects their objectives and assesses their performance appropriately (Kennerly & Neely, 2002, p. 146). Besides tendency to link operations and processes to strategic goals, they integrate financial and non-financial measures, and focus all business activities on customer requirements (Lynch & Cross, 1995, p.6). Nevertheless, these different approaches have led to numerous definitions of a performance measurement system, but still, there is little consensus regarding its main components and characteristics (Dumond, 1994, p.17).

Some of the most common models in the literature are: Tableau de Bord - TB (de Guerny et al, 1990; Neely et al, 2007), Activity based costing – ABC method (Budd, 2010), Data Envelopment Analysis - DEA (Berg, 2010; Savić, 2012), Theory of Constraints - TOC (Goldratt, 1984), Performance measurement matrix (Keegan et al, 1989; Neely et al, 2007), Performance pyramid (Lynch & Cross, 1991), Framework of results and determinants (Fitzgerald et al, 1991; Neely et al, 2007), Balanced Scorecard - BSC (Kaplan & Norton, 1993), EFQM model (Neely et al, 2007; EFQM, 2009), DOE/NV model (Bellman et al, 1994; Franceschini et al, 2007), TQM performance measurement model (Sinclair & Zairi, 1995; Sinclair & Chang, 2002), Brown's performance measurement concept (Brown, 1996;), Supply Chain Operations Reference (SCOR) model (Supply-Chain Council, 2010), Demand to measure model - DtM (Ljungberg, 2002), Kanji Business Excellence Measurement System - KBEMS (Kanji, 2002; Naghavi et al, 2012); Business System Design Decomposition framework - BSDD (Taticchi et al, 2010).

2.3. Comparative analisys of PPM models

Those models were according to twelve criteria (Simeunović, 2015). One of the criteria was model flexibility, which implies the ability to use models in a wide and varying range of companies, ie model applicability in a number of companies, with no significant changes in the model. For research purposes, model flexibility is defined on the four levels, as shown in Table 1.

The results of comparative analysis show that five models are applicable to all organizations without major changes, but these models are limited to the level of processes, ie do not consider organization as a whole. Six models can be applied in different type of organizations, but only to a certain level, ie performance indicators must be defined again for each organization, and that's time consuming, so they can not be considered as fully flexible models. Only two models (EFQM, TOC), according to the results of the analysis, have sufficient flexibility.

However, EFQM model is not recommended to be used in developing countries, because of high demands on achieving business performance, so it is not suitable for use in the companies in Serbia. From the other hand, Theory of constraints is far from being a complete performance measuring system (Striteska & Spickova, 2012, p.9), and it is difficult for applying in changing environment. Based on previous, it can be concluded that the flexibility of analyzed PM models is not satisfactory.

Table 1: PM model classification - model flexibility asspect (Simeunovic et al, 2015)

Level	Description of level	Model
1	Model is not flexible, ie it is defined only for specific type of organizations	Framework of results and determinants, TQM, SCOR
2	Model is flexible to some extent, ie, it is applicable in all types of organizations, but with significant changes in the model	TB, PM matrix, Performance pyramid, BSC, DOE/NV, BSDD
3	Model is flexible, ie, it is applicable in a wide and varying range of companies, but only at process level (not at whole organization level)	ABC, DEA, Brown's model, DtM, KBEMS
4	Model is fully flexible, ie it is it is applicable in a wide and varying range of companies, with no significant changes in the model	TOC, EFQM

Therefore, there is the need for rapid adjustment of PM system to changing business environment. The development of PM model, that starts from the strategic objectives defined in accordance with the stakeholders' requirements, and translates them on the goals of lower hierarchical levels, and then connects them with key performance indicators processes (which realize defined objectives), will allow the connection of strategic objectives and key process performance indicators. By this, the flexibility of the model, i.e. its simple and easy applicability in the various organizations, can be increased.

2.4. Hypotheses

Based on previous, the following general research hypothesis is proposed:

H0. By defining a universal set of goals at the highest level of the organization, a universal set of goals of organizational units and the universal set of process performance indicators, the PM system flexibility could be improved.

To examine this general hypothesis more thoroughly, it is separated into five smaller sub-hypotheses:

H1: By applying the process management based PM model is possible to define the higest level goals of organization in accordance with the stakeholders' requirements.

H2: The highest level goals of organization can be generalized (the universal set of highest level goals can be defined).

H3: By decomposing the highest level goals to the goals of organizational units, key processes can be identified.

H4: By applying the process management based PM model is possible to identify proces performance indicators.

H5: It is possible to identify the universal set of process performance indicators, which can be measured and monitored in each process-orientied bussines system.

3. RESEARCH METHODOLOGY

In order to test the proposed hypotheses, it was decided to conduct case studiy research on the domestic market. Although geographical area wasn't significant, due to the possibility of data collection, research was limited to Serbia. Case study was conducted according to guidelines for case study research proposed by Eisenhardt (1989).

During planning research, intention was to test initial process management based PM model in process-oriented organizations, and then, to analyse decomposition of stretegic goals of organization onto the organizational units' goals, as well as their conection with key process performance indicators.

The unit of analisys for the case study was bussines system, i.e. organization. Selection criteria were designed process model in the organization, and data availability (possibility of data collection). Research was conducted from October 2011 to February 2013. Proposed model was tested at 31 cases, i.e. in 31 organization.

During the research, detailed examination of the documentation on the strategic goals and organizational processes was performed. In order to obtain insight about selected organizations, available documentation from the organizations' web-sites, as well as information on the current PM practice were thoroughly reviewed. The proposed PM model was tested in all selected organizations, and the obtained results were further used for testing hypotheses, as well as for the model improvement.

4. CASE STUDY RESEARCH

4.1. Description of initial PM model

The first step in establishing process-oriented performance measurement system is the development of mission and vision statement. The mission can be seen as the far goal that may never be reached. It should describe what the organization is in business to do. The vision is where the company wants to go, the ideal future state of the organization. Well-defined mission statement should facilitate product/service identification, on the one hand, and identification of stakeholders, and their requirements, on the other hand. Vision statement, along with identified stakeholders, are the basis for defining those product/service quality features by which the organization meets the requirements of stakeholders. Considering the importance of stakeholders for the success of the organization, their requirements should be than incorporated into the strategy and translated into measurable organizational goals. Furthermore, company should decompose those organizational goals to lower level goals of organizational units. At the same time, according to mission, the basic product/service (or more basic products/services) should be identified, and the product/service catalogue should be created, which is the basis for business process identification, i.e process model design. Next step is to identify those processes and activities that (from process model) lead to achievement of organizational goals, and whose performance indicators should be measured. However, since it is impossible to simultaneously improve all processes, or to measure performances of all processes, due to limited resources and time, considering that all performances are not equally important, efforts should be focused on measuring the performances of those processes whose execution contributes to achievement of the organizational goals or stakeholders requirements. So, the list of prior, critical and key processes should be created, whereby the key processes are those processes through which the specificity of business system can be recognized and which contribute to business system goals realization. Given the above mentioned, it is necessary to select the key processes that will be measured and managed. The next step is to translate the top level goals into key process performance indicators which lead to the achievement of these goals. The degree to which goals, as a mission, are met is determined by measuring and comparing process performance with a defined goal (Simeunović et al, 2014).

Translation process is performed as follows. The strategic goals of the organization, aligned with the requirements of stakeholders, are decomposed into the lower level objectives, i.e. objectives of the business system units. If an organization achieves goals of its organizational units, the highest level goals will be achieved too. In this step, it's necessary to define the units of measurement, reference values (values that are required for goal achieving), the method of measuring these goals, and to describe how (in which interval) the trend of achieving these goals will be followed. Next step is to determine which processes in organization should be performed in order to achieve those second level goals. Then, for each of these processes, performance indicators which will be measured and monitored, have to be defined. In this way, process performance indicators are directly linked with organizational units' goals, but also, indirectly, with the highest level goals of organization. The logic and procedure for translating the business system's goals in process performance indicators are shown in Figure 1.

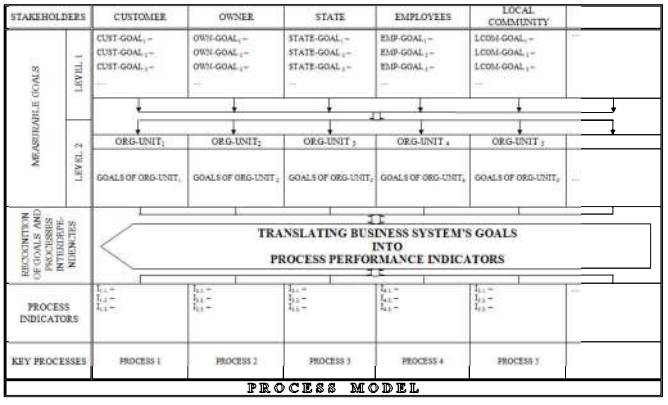


Figure 1. Procedure for translating the business system's goals in process performance indicators (Radović at al, 2012, p.129)

4.2. Results

The proposed model has been applied in 31 companies, which have been the subject of case study. Among 31 companies, 9 were small companies (29%) with less than 50 employees, 12 were medium companies (38,7%) and 10 (32,3%) were large companies (with more then 250 employees) . When it comes to business field that the company is operating in, 13 (41,9%) were service oriented, 14 (45,2%) were manufacturing companies, while only 4 (12,9%) were operating both in service and manufacturing industry.

The stakeholders, that are recognized in those companies are: customers, owner, state, local community, employees and suppliers.

Detailed overview of the companies as well as the results of applying the model in those companies are shown in (Simeunović, 2015).

5. DISCUSSION

Proposed model was applied in 31 companies in Serbia, and on the basis of the collected data, the universal list of the highest level goals (that are defined according to stakeholders' requirements) was obtained. The list include a total of 37 different goals that are defined (in the same or similar way) in these companies. Golas are given in a general form, and their quantification, ie closer specification is done for each organization in particular. Proposal of the list of goals, based on case studies, and the percentage of companies that defined these goals are given in (Simeunović, 2015).

Based on the abovementioned, the sub-hypotheses H1 and H2 were confirmed.

After defining the universal list of the highest level goals, these goals were, for each company, decomposed to the goals of the organizational units, which are responsible for accopmlishing the highest level goals. A total of 32 goals of organizational units were identified.

Furthermore, the key processes (that contribute to realization of these goals) were recognized in each company. All these key processes were then categorized, resulting in the list of 19 key processes (in general form). Performing those processes enables achievement of predefined goals in all companies (from case study). Detailed review of these processes can be found in (Simeunović, 2015).

Based on the abovementioned, the sub-hypothesis H3 was confirmed.

For each process, the process performance indicators (one or more), which will be measured and monitored, were defined. Based on data on process performance indicators collected in all the companies (which were the subject of case studiy), the universal list of process performance indicators was defined. Based of that list, each company, regardless of the activeness, form of ownership, size and form of organization, may select its own set of indicators, in order to monitor and assess the achievement of goals. The list includes 172 process performance indicators, shown in (Simeunović, 2015).

Based on the abovementioned, the sub-hypotheses H4 and H5 were confirmed.

Confirming sub-hypotheses H1-H5, the general research hypothesis is accepted:

H0. By defining a universal set of goals at the highest level of the organization, a universal set of goals of organizational units and the universal set of process performance indicators, the PM system flexibility could be improved.

6. GPI PROCESS PERFORMANSE MEASUREMENT MODEL

Based on research, the initial PM model was improved, and the improved version of model is named GPI process performance measurement model. The model was named as the acronym of three key words that form its structure: Goals, Processes and Indicators.

GPI model can be used in its narrower and broader version. Narrower version of GPI model allows application of model just as it is, without any changes (emphasizes flexibility), while broader version of the model implies its adaptation to the needs of concrete business system (emphasizes adaptability). Since the topic of the paper is PM models flexibility, the narrower version of GPI model will only be shown.

In the model, the highest level goals of the organization are predefined, as well as the goals of organization units, key processes and their performance indicators. The links between them are determined too. The model is specified based on case study research and it can be used (as such) in every business system, which means that it is extremely flexible.

Based on case study, the highest level goals of each company were analyzed, and the universal list of these goals, which contains a total of 12 different goals was defined. The list is shown in Table 2.

Table 2: Universal list of the highest levell goals, and theirs labels (Simeunović, 2015)

RB	Label	Goal
1	CKO_1	Improve/maintain product/service quality
2	CKO_2	Cut short/fulfill deadlines
3	CKO_3	Reduce/keep product/service price
4	CVL_1	Increase profit
5	CVL_2	Develop bussines
6	CZA_1	Increase wages
7	CZA_2	Improve work conditions
8	CZA_3	Provide training for staff
9	CDO_1	Regularly pay payables to suppliers
10	$CDR\text{-}LZ_1$	Regularly pay taxes and contributions
11	$CDR\text{-}LZ_2$	Increase employment/decrease unemploymenti
12	$CDR\text{-}LZ_3$	Protect environment/meet environmental requirements

It was also determined that the achievement of the defined goals can be monitored with a total of 20 process performance indicators. It is important to note that key processes should always be identified first, and then the indicators of these processes. But, considering that the final result (output) of model is the direct link betveen the highest level goals and process performance indicators, in Table 3, process performance indicators were first presented, and then the key processes in which these indicators should be measured.

Table 3: Process performance indicators, their labels and key processes (Simeunović, 2015)

RB	Code	Proces performance indicator	Key Process
1	IKV_2	The waste percentage	Product production / service provision
2	IKV_3	The percentage of non-compliant pieces	Product production / service provision
3	IKV_{21}	Percentage/number of (non)compliance with environmental requirements	Quality service provision / Quality Control
4	IKV_{24}	Number of corrective measures	Quality service provision / Quality Control
5	IKV_{31}	The complaint rate	Sales service provision; Collection and processing of complaints
6	IPR_1	(Annual) production volume	Product production / service provision
7	ITR_1	Total (annual) production costs	Product production / service provision
8	ITR_2	The cost per unit of product/service	Product production / service provision
9	IRO_{15}	The percentage of on-time deliveries	Product production / service provision; Providing services logistics / warehousing / transport; Providing services procurement
10	IRO_{16}	(Average) delivery time	Product production / service provision; Providing services logistics / warehousing / transport; Providing services procurement
11	IRZ_1	The number of new types of products or services (per year)	Product design and development; R&D service provision
12	IRD_1	The total number of employees of a particular profession (in a particular organizational unit)	HR services provision / training and professional development
13	IRD_7	The number of workers who have attended training/seminar/specialization	HR services provision / training and professional development
14	IRD_8	Number of organized seminars / trainings (per year / on a particular topic)	HR services provision / training and professional development
15	IRD_{15}	The rate of employee satisfaction with working conditions	HR services provision / training and professional development
16	IPD_2	(Annual) sales volume	Sales service provision
17	IMA_1	The market share (domestic or EU)	Marketing service provision/Market Research
18	IMA_{11}	(New) customer acquisition rate	Marketing service provision/Market Research
19	IFI_6	The amount of unpaid liabilities / unpaid net earnings	Financial service provision/ Payment process
20	IFI_7	Amount of (un)paid liabilities on time	Financial service provision/ Payment process

The names of key processes are generalized, and for operational usage of model, it is preferred to adapt their names to the specific company.

Interdependence of the the highest level goals and process performance indicators can be represented as follows (Simeunović, 2015):

CKO_1=f (IKV_{31}, IKV_2, IKV_{24}, IKV_3)
CKO_2=f (IRO_{16}, IRO_{15})
CKO_3=f (ITR_1, IKV_2, ITR_2)

CVL_1= f(all defined process performance indicators)
CVL_2 = f (IRZ_1, IMA_1, IPR_1, IPD_2, IMA_{11})

CZA_1=f(all defined process performance indicators)
CZA_2= f (IRD_8, IRD_{15})
CZA_3=f(IRD_8, IRD_7)

CDO_1=f(IFI_6, IFI_7)

CDR-LZ_1=f(all defined process performance indicators)
CDR-LZ_2 = f (IMA_1, IRD_1, IPR_1, IRZ_1)
CDR-LZ_3=f(IKV_{21})

7. CONCLUSION

Since a contemporary management of the organization involves management of its processes, the achievement of organization's goals depends on the success of its processes. The success of the process, ie their ability to meet organizational goals, is measured by using key performance indicators.

Analysis of the existing PM models showed that only a few of them has a certain flexibility, ie that is applicable to all organizations, without major changes. However, these models are applicable only at process level (not at whole organization level). Some PM models can be applied in different type of organizations, but only to a certain level, ie performance indicators must be defined again for each organization, and that's time consuming, so they can not be considered as fully flexible models.

Accordingly, the new GPI process performance measurement model is proposed, which is based on process management. This model starts from the highest level goals (that are defined according to stakeholders' requirements), decomposes them on the goals of organizational units and links them to the key processes performance indicators. In this way, GPI model allows specification of a universal set of the highest level goals and universal set of process performance indicators, thereby increasing the model flexibility.

In order to verify validity of the model, a case study research was done. Proposed model was tested at 31 cases, i.e. in 31 organization that manage their processes. Research was conducted from October 2011 to February 2013. Based on the study findings, previously conceptualized model is improved.

The narrower version of GPI model, which is presented in the paper, is applicable in each company, regardless of the activeness, form of ownership, size and form of organization. In the model, the highest level goals of the organization are predefined, as well as the goals of organization units, key processes and their performance indicators. The links between them are determined too. The model is specified based on case study research and it can be used (as such) in every business system, which means that it is extremely flexible.

Results of research and proposed GPI model create the basis for better and easier performance management, but also for further research in this area.

REFERENCES

Addison, R., Haig, C., & Kearny, L. (2009). *Performance architecture: The art and science of improving organizations.* San Francisco: Pfeiffer.

Bellman, R., Droemer, D., Lohmann, M., & Miller, C. (1994). *Performance Measurement Process Guidance Document*. Las Vegas: Department of Energy.

Berg, S. (2010). *Water utility benchmarking: measurement, methodologies, and performance incentives*. London: IWA Publishing.

Brown, M.G. (1996). *Keeping Score: Using the Right Metrics to Drive World-Class Performance.* New York: Quality Resources.

Budd, C. S. (2010). Traditional Measures in Finance and Accounting, Problems, Literature Review, and TOC Measures. In: J.F. Cox III, & J. G. Schleier Jr, (Eds), *The Theory of Constraints Handbook*, 335-371. New York: McGraw-Hill.

De Guerny, J., Guiriec, J.C., & Lavergne, J. (1990). *Principes et Mise en Place du Tableau de Bord de Gestion* (6th ed.). Paris: J. Delmas.

Del-Río-Ortega, A., Resinas, M., & Ruiz-Cortés, A. (2010). Defining process performance indicators: An ontological approach. In *On the Move to Meaningful Internet Systems: OTM 2010*, 555-572. Berlin: Springer Berlin Heidelberg.

Dumond, E. J. (1994). Making Best Use of Performance Measures and Information. *International Journal of Operations & Production Management*, *14*(9), 16- 31. doi:10.1108/01443579410066712

EFQM. (2009). *EFQM Excellence Model.* Brussels, Belgium.

Eisenhardt, K. M. (1989). Building theories from case study research, *Academy of Management Review, 14*(4), 532-550. doi:10.5465/AMR.1989.4308385

Fitzgerald, L., Johnston, R., Brignall, T. J., Silvestro, R., & Voss, C. (1991). *Performance Measurement in Service Businesses.* London: Chartered Institute of Management Accountants.

Franceschini, F., Galetto, M., & Maisano, D. (2007). *Management by measurement - Designing key indicators and performance measurement systems.* New York: Springer Berlin Heidelberg.

Goldratt, E. M. (1984). *The Goal.* Great Barrington: The North River Press.

Kanji, G. K. (2002). Performance Measurement System. *Total Quality Management, 13*(5), 715-728. doi: 10.1080/0954412022000002090

Kaplan, R. SR., & Norton, D. P. (1993). Putting the Balanced Scorecard to Work. *Harvard Business Review, 71*(5), 134-147.

Keegan, D. P., Eiler, R. G., & Jones, C. R. (1989). Are your performance measures obsolete? *Management Accounting, 70*(12), 45–50.

Kennerley, M., & Neely, A. (2002). A framework of the factors affecting the evolution of performance measurement systems. *International Journal of Operations & Production Management, 22*(11), 1222-1245. doi: 10.1108/01443570210450293

Ljungberg, A. (2002). Process measurement. *International Journal of Physical Distribution and Logistics Management, 32*(4), 254 - 287. doi: 10.1108/09600030210430642

Lynch, R. L., & Cross, K. F. (1991). *Measure Up! Yardsticks for Continuous Improvement.* Cambridge: Blackwell.

Lynch, R. L., & Cross, K. F. (1995). *Measure Up!: How to Measure Corporate Performance.* Oxford: Blackwell Publishers.

Naghavi, M. A. S., Asri, G. M., Ezzati, M., Zarandi, M., & Hosseini, S. A. (2012). Performance assessment at Iran's electric power distribution company: A study based on Kanji's business excellence measurement system (KBEMS). *African Journal of Business Management, 6*(29), 8539-8547. doi: 10.5897/AJBM11.1569

Neely, A.D., Kennerley, M., & Adams, C. (2007). Performance measurement frameworks: a review. In: A. Neely (Ed), *Business Performance Measurement, Unifying theories and integrating practice*, 143-162. Cambridge, UK: Cambridge University Press.

Parmenter, D. (2010). *Key Performance Indicators – Developing, Implementing, and Using Winning KPIs.* New Jersey: John Wiley & Sons, Inc.

Radović, M., Tomašević, I., Stojanović, D., & Simeunović, B. (2012). *Inženjering procesa*. Beograd: FON.

Rosemann, M., & vom Brocke, J. (2010). The six core elements of business process management. In: J. vom Brocke & M. Rosemann (Eds), *Handbook on Business Process Management. Introduction, methods and informations system,* 107-122. Berlin: Springer.

Rouse, P., & Putterill, M. (2003). An integral framework for performance measurement. *Management Decision*, *41*(8), 791-805. doi: 10.1108/00251740310496305

Savić, G. (2012). *Komparativna analiza efikasnosti u finansijskom sektoru* (Doktorska disertacija, FON, Breograd).

Sikavica, P., & Hernaus, T. (2011). *Dizajniranje oganizacije - strukture, procesi, poslovi.* Zagreb: Novi informator.

Simeunović, B., Radović, M., & Slović, D. (2014, June). Novel approach to business process performance measurement. Paper presented at the *XIV International Symposium of Organizational Sciences: New Business Models and Sustainable Competitiveness.*

Simeunović, B. (2015). *Razvoj modela za merenje performansi procesa* (Doktorska disertacija, FON, Breograd).

Simeunović, B., Slović, D., & Radaković, J.A. (2015). Analiza modela za merenje performansi procesa. *Škola biznisa*, 2, 49-64. ISSN: 1451-6551, 2406-1301. (online), UDK. 330

Sinclair, D. A., & Chang, H.,H. (2002). Validation of A Model of Total Quality Management Performance Measurement Systems in the UK. *Asia Pacific Management Review, 7(3)*, 349-380.

Sinclair, D., & Zairi, M. (1995). Effective process management through performance measurement: Part III - An integrated model of total quality-based performance measurement. *Business Process Re-engineering & Management Journal*, *1(3)*, 50-65.

Striteska, M., & Spickova, M. (2012). Review and Comparison of Performance Measurement Systems. *Journal of Organizational Management Studies, 2012.* doi: 10.5171/2012.114900

Supply-chain operations reference. (n.d.). Retrived from http://en.wikipedia.org/wiki/Supply-chain _operations_ reference

Taticchi, P., Cagnazzo, L., Santantonio, M., & Tonelli, F. (2010). A framework for performance measurement and management based on axiomatic design and analytical hierarchy process. In: P. Taticchi (Ed.), *Business performance measurement and management - new contexts, themes and challenges*,229-240. Berlin: Springer-Verlag.

Turajlić, N., Nešković, S., & Vučković, M. (2009). Mesto mera performansi u modelima poslovnih procesa. *INFOTEH-Jahorina, 8*, 598-602.

DETERMINATION OF FAILURE DISTRIBUTION PARAMETERS FOR BANBURY MACHINE

M. Şirin Aydın*[1], Baha Güney[1], Çağatay Teke[1]
[1]Sakarya University
*Corresponding author, e-mail: sirin.aydin@ogr.sakarya.edu.tr

Abstract: *Planning, conducting and control of maintenance activities enable to the highest level of availability of manufacturing machines. Maintenance is a set of activities that carry out to keep a system or equipment in operation. Maintenance activities are basically divided into two types as preventive maintenance and corrective maintenance. Failure distribution of machines and equipment has to be known for planning space parts, labor and tools. This can be determined by using failure data and suitable statistical method. In this study, failure distribution parameters of banbury machine were determined by using real failure data. Applied method was shown for the equipment which is vitally important.*

Keywords*: failure distribution parameters, maintenance, banbury machine, weibull distribution, maximum likelihood estimation*

1. INTRODUCTION

Tyre manufacturing process should be formed and managed properly in order to ensure completion of the process in time. The maintenance planning of Banbury machines used in tyre manufacturing should be arranged such that availability is always at a maximum level. In addition, spare part, labor and equipment planning should also be carried out properly so that maintenance activities can be carried out as planned. It is possible to do this for preventive maintenance activities since the times have already been scheduled. However, the same is not true for corrective maintenance activities. Because it is not known when there will be a failure. If the past failure data are available for the system or component for which corrective maintenance activities will be carried out, this uncertainty can be decreased significantly. Since past failure data will fit a certain statistical distribution and if the parameter values for this distribution are determined then it is possible to carry out spare part, labor and equipment planning based on the failure time estimations.

2. LITERATURE REVIEW

Zeytinoglu (2009) conducted a study to determine the weibull distribution parameters for a material that is being used as the printing unit of a photocopier. Graphic method, least squares method, maximum likelihood method and moment method were used for parameter estimation. At the end of the study, results of methods were compared. Kurban, Kantar and Hocaoglu (2009) used weibull distribution for analyzing wind speed and wind power. Moment method was used for parameter estimation. Razali and Al-Wakeel (2013) used mixture of two or three parameters Weibull distributions for fitting failure times. Maximum likelihood estimation method was used for estimating the parameters. Kurz, Lewitschnig and Pilz (2014) carried out a study to determine the weibull distribution parameters by using advanced Bayesian model. Time-to-failure and discrete failure count data belongs to burn in period were investigated for parameter estimation. Tan (2008) developed a new approach for two parameter weibull distribution parameter estimation to cope with interval data. Maximum likelihood estimation method was used for parameter estimation. Demonstration and validation of the approach were shown with data generated by Monte Carlo simulations. Zhang and Dwight (2013) performed a study for choosing an optimal model for failure data analysis by using graphical approach. Different shapes of plots on Weibull probability paper were created by using data. Selection of optimal model for failure data analysis is based on the shapes of the fitting plots. Abbasi, Jahromi, Arkat and Hosseinkouchack (2006) conducted a study to determine the weibull distribution parameters by using simulated annealing algorithm. Hung and Chang (2011) carried out a study for determining the mixed-weibull distribution parameters. Moment method and regularization type of fuzzy clustering algorithm were used for parameter estimation. Chu and Ke (2012) performed a study to determine the weibull distribution parameters. Least squares method and maximum likelihood estimation method were used for parameter estimation. Performance of two methods was evaluated via numerical simulation. Kaplan (2016) used weibull distribution and rayleigh distribution for analyzing wind energy potential of Osmaniye city. Moment method and graphical method were used for parameter estimation.

3. MAINTENANCE

Maintenance covers all the actions carried out to repair or to ensure that a unit, part or equipment continues to work under certain conditions (Dhillon, 2002). With regard to production systems, maintenance activities are those that are carried out so that all production systems or certain equipment are in working order. This definition shows that maintenance function covers not only intervention to a failure but also proactive tasks such as routine inspection, preventive maintenance, replacement and condition monitoring.
Various decisions related with specifications, purchasing, planning, operating, performance evaluation, development, replacement and scrapping are made for every stage of the life curves of various technical systems such as factories, machinery, equipment or plants within the scope of maintenance management. Maintenance management is thus the management of physical assets based on this wide perspective (Köksal, 2007).

3.1. Corrective Maintenance

It would be wiser to explain the concept of failure prior to corrective maintenance. Failure is the stopping of a system or the decrease in production rate and/or quality due to an unpreventable reason. In this method, intervention or repair is carried out after the failure. The machine or machines stop until repair. Maintenance crew and maintenance workshop strive to start the production system in the shortest possible time. Spare machines or spare parts are put into use if any so that the line continues working.
In corrective maintenance, a machine does not go through maintenance unless there is a failure. Other maintenance works are carried out with the repair when there is a failure. Most of the repairs are quick-fixes that are made to ensure that the failed part is repaired and that the machine continues to operate. These companies operate as minimum repair and work with professional maintenance companies for large maintenance-overhaul works. This is a management approach that minimizes maintenance crew and material costs (Köksal, 2007).
Corrective maintenance is observed most frequently in the following cases (Köksal, 2007):

- Small workshops with general purpose universal workbenches,
- Facilities that are planned to be sold out because they have become outdated or idle due to the changes in the market,
- In cases when there is more than one spare equipment in the facility (e.g. when there are three parallel connected equipment and one of them fails)
- Activities that support main production (forklift, compressor and similar equipment)

3.2. Preventive Maintenance

In this method, the machinery equipment, buildings or facilities go through inspection at certain periods and before any failure arises and protective activities such as machinery adjustment, cleaning, part replacement, painting and other minor repairs are carried out if necessary. It is a preventive activity (Köksal, 2007). Preventive maintenance should have the following properties (Köksal, 2007):

- Oiling: An oiling program should be included in all preventive maintenance policies. It should be carried out with trained personnel.
- Inspection: The condition of machinery equipment is under constant control with regular inspections. It should be decided to stop the machine for maintenance prior to the arising of any changes due to heat, vibration or wear.
- Programmed power off or maintenance: It is the planning of short or long term general maintenance or power off maintenance work. Transfer workbenches, heat treatment ovens, presses and reactors for short term.

The preventive maintenance activities listed above are generally carried out outside the production hours so that the operation is not stopped.

4. FAILURE DISTRIBUTIONS

When the failures in a system or component are recorded, it will be observed that the failure data fit a certain statistical distribution. When the current failure data are evaluated statistically, it will fit a distribution and the parameters of that distribution will take on values. The parameter values of the distribution will yield the

failure distribution of the related system or component. Based on this information, failure times will be estimated and maintenance planning will be made.
Even though there are many models used for failure distribution, the most widely used are weibull distribution, exponential distribution and normal distribution.

4.1. Weibull Distributions

Weibull distribution was put forth by Waloddi Weibull in 1951 in order to estimate the life times of machines. Today, it is used in the statistical models that are part of the science of engineering as well as in life data analysis. Weibull distribution is widely used in models that will be set up for the data set related with failure ratios which in some cases has a Rayleigh or exponential distribution based on the values that the shape parameter takes.
In general, the Weibull distribution is one that has a scale and shape parameter. The two parameter weibull probability density function is given below:

$$f(T) = \frac{\beta}{\eta}\left(\frac{T}{\eta}\right)^{\beta-1} exp\left[-\left(\frac{T}{\eta}\right)^{\beta}\right] \quad (1)$$

Here, f(T) ≥ 0, T ≥ 0, β > 0, η > 0 and β is the shape parameter, η is the scale parameter. The two parameter weibull cumulative distribution is given below:

$$F(T) = 1 - exp\left[-\left(\frac{T}{\eta}\right)^{\beta}\right] \quad (2)$$

One of the parameters of the Weibull distribution is the shape parameter and the reason for various different distributions is the value that the shape parameter takes. Failure rates increase over time when the slope value ranges between 0 and 1, that is when 0 < β <1. As a special case, when β =1, "f(T)=1/η exp(-T/η)" distribution is an exponential distribution. Here, "1/η =λ" represents the failure rate. When β = 2, it becomes the rayleigh distribution (Zeytinoğlu, 2009).

5. DETERMINING THE PARAMETER VALUES OF THE DISTRIBUTION

Statistical models mostly depend on data for estimations. The accuracy of any estimation depends on the completeness and quality of the data to be used. A good estimation can be made when a good data set is combined with the right model. The data that we will use when determining the parameter values of failure distribution may not be complete, they may include some uncertainties. Thus, we can classify the data used for analysis as complete data and censored data.

5.1. Complete Data

Complete data means that every sample unit has been observed and is known. For example, if we are testing five units and if all five of these units have failed during testing then it means we have complete data (http://reliawiki.org/index.php/Life_Data_Classification, 03.06.2013).

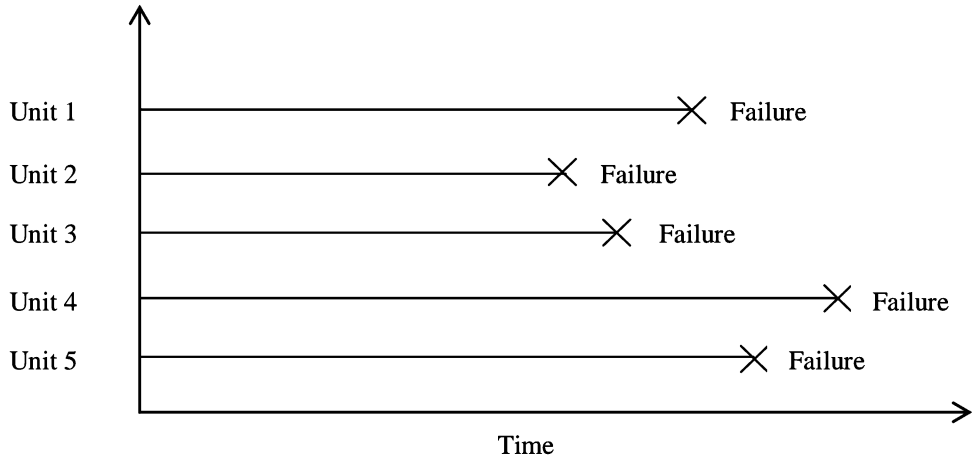


Figure 1: Complete Data

5.2. Censored Data

In many cases, not all sample units fail during testing or there may be instances when we cannot detect the exact time of failure. Such data are known as censored data. There are three types of censored data: right censored, interval censored and left censored (http://reliawiki.org/index.php/Life_Data_Classification, 03.06.2013).

5.2.1. Right Censored Data

It is the most common among censored data. For example, if we have tested five units and if only three of these units have failed until the end of the test, it means we have two right censored data (http://reliawiki.org/index.php/Life_Data_Classification, 03.06.2013).

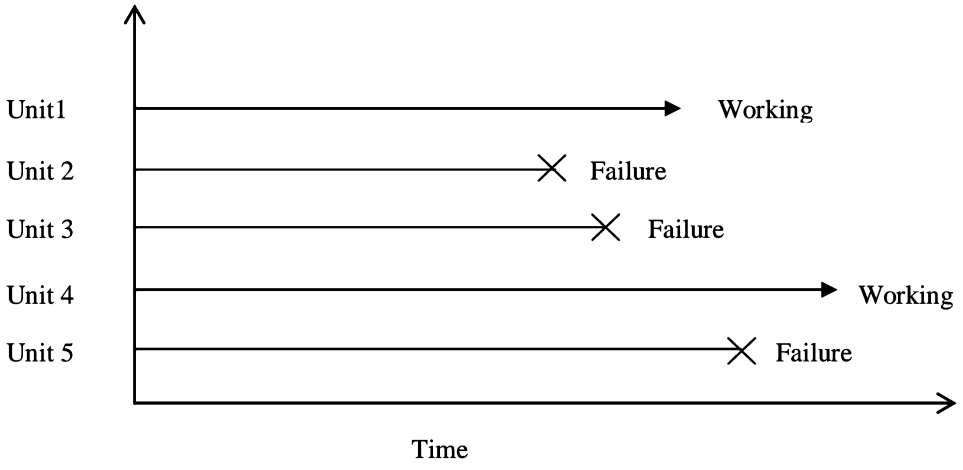


Figure 2: Right censored data

5.2.2. Interval Censored Data

Interval censored data represents the uncertainty regarding the time of failure of the tested unit. Thus, it is not certain when the unit has failed. This is observed in cases when the related unit is not under constant monitoring. For example, if we are testing 5 units and we observe these units every 100 hours, we can only know if the units failed between the observation times. If we are to give a more detailed explanation; if we observe that the unit is functioning at the end of the first 100 hours and that it has failed at the end of the second 100 hours, we can state that this unit has failed during 100-200 hours (http://reliawiki.org/index.php/Life_Data_Classification, 03.06.2013).

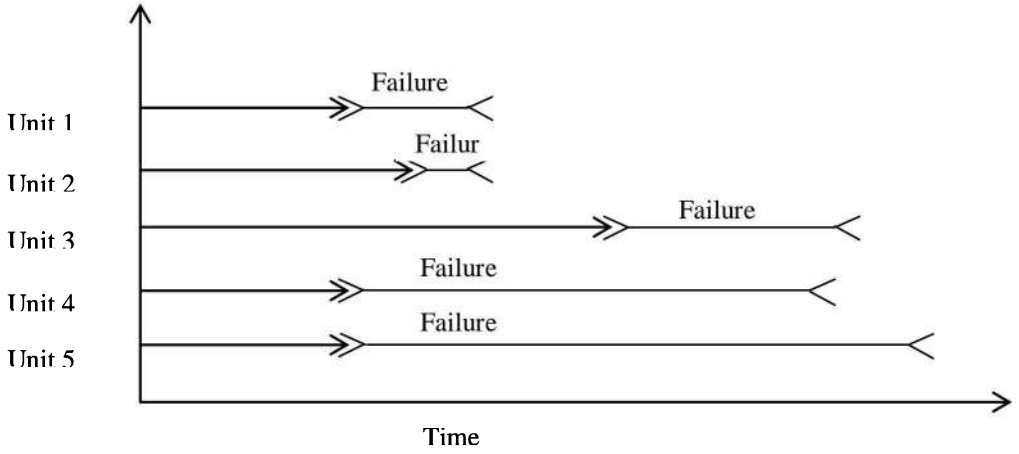


Figure 3: Interval censored data

5.2.3. Left Censored Data

For left censored data, we can know if the tested units have failed before a certain time or not. For example, we can state that the unit has failed before 100 hours, however we cannot give an exact time. In other words, this means that the unit has failed at some point in the 0-100 hour interval (http://reliawiki.org/index.php/Life_Data_Classification, 03.06.2013).

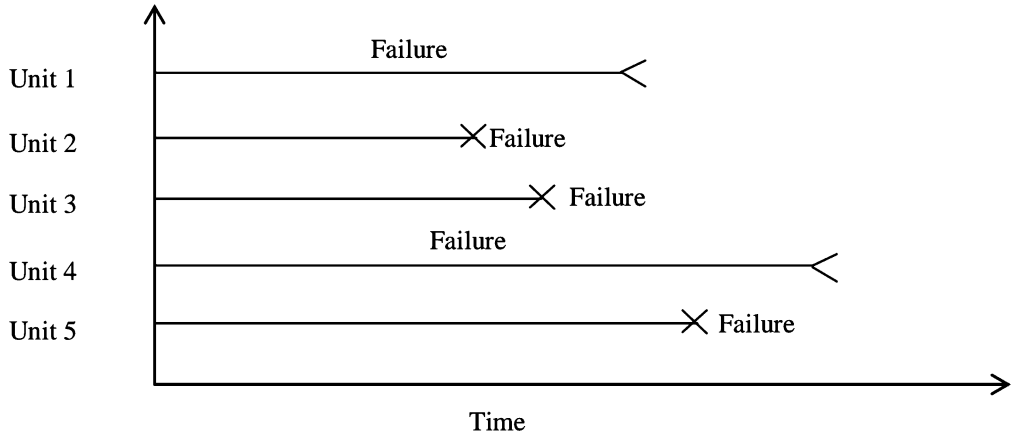


Figure 4: Left censored data

6. APPLICATION

Failures of banbury machines used in tyre manufacturing have been handled in the application. Banbury machines play an important role for tyre manufacturing process. Indeed, banbury machines failures significantly effect it.

Maximum likelihood estimation method, probability plotting, least squares method and moment method can be listed as methods used to estimate the parameter values of failure distribution. In this study, banbury machines failure data were used to calculate the weibull distribution parameter values using Minitab software in accordance with the maximum likelihood estimation method.

6.1. Maximum Likelihood Estimation Method

k and c are shape and scale parameters respectively in Weibull distribution. Maximum likelihood estimation is one of the methods used to calculate these parameters. Failure data comprise a set of n elements such as $v_1, v_2, \dots\dots\dots\dots v_n$ when using this method. The probability of $V = v_i$ in the observation is proportional with $f(v_i; k, c)$. Similarly, the probability of events occurring can be expressed as $V = v_1 \dots\dots V = v_n$. Since the events are independent of each other, the probability of events $L = \prod_1^n, \dots\dots V = v_n$ occurring can be written as such:

$$L = \prod_1^n f(v_i; k, c) \tag{3}$$

Scale parameter;

$$c = \left[\frac{\sum_{i=1}^n (v_i)^k}{n}\right]^{\frac{1}{k}} \tag{4}$$

Shape parameter;

$$k = \left[\frac{\sum_{i=1}^n v_i^k In(v_i)}{\sum_{i=1}^n v_i^k} - \frac{\sum_{i=1}^n In(v_i)}{n}\right]^{-1} \tag{5}$$

is obtained with these equations.
It is difficult to solve the equation since it is iterative. Hence, it is not a method used before modern technology (Akdag and Guler, 2008).

6.2. Determination of Failure Distribution Parameters

The analysis was conducted with dip tank failure data of banbury machine which is used in tyre manufacturing. Failures of dip tank are of crucial importance for banbury machine because they affect running of the system substantially. Banbury machine has a dip tank. Failure data of the dip tank was recorded for 365 days. 35 dip tank failures are available during the analysis period Thus; we have 35 complete data.

Failure data of the dip tank have been entered in the Minitab software and the weibull distribution parameters for it have been determined. “Failure” expression was used for complete data while entering the failure data into the software. Parameter values for the two parameter weibull distribution have been determined as β=0,287 and η=38,8481 in hours. In addition, the mean time to failure value for the dip tank has been determined approximately as 440 hours. In other words, the average life of it is 440 hours. The screenshot of the software used for analysis has been given below:

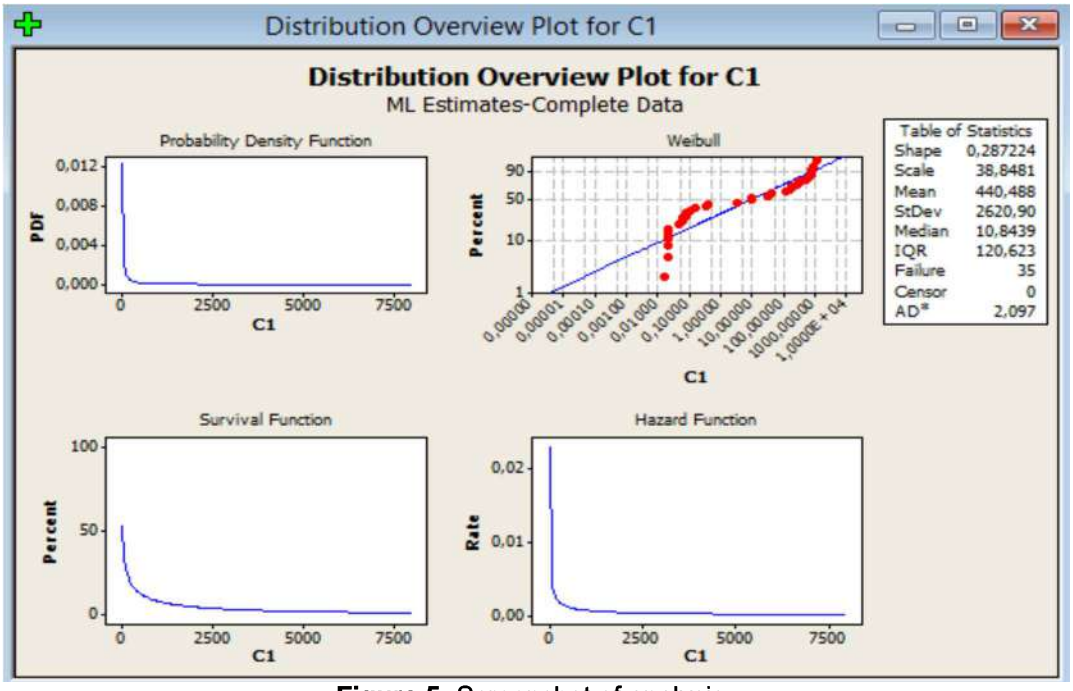


Figure 5: Screenshot of analysis

7. CONCLUSION

Planning of spare parts, labor and equipment to be used in maintenance activities has to be carried out accurately in order to ensure that the planning activities are executed in a planned manner. It is possible to do this for preventive maintenances, because the maintenance times are predetermined. However, the maintenance time is not certain for corrective maintenance activities since it is not known beforehand when a failure will arise.

In this study, failure data of banbury machine used in tyre manufacturing have been used to determine the failure distribution parameters via Minitab software in accordance with the maximum likelihood estimation method. In this way, failure times will be estimated and corrective maintenances will be carried out in proper manner. Since the spare part, labor and equipment planning will be carried out in accordance with this estimated value.

8. FUTURE WORK

While determining the failure distribution parameters, failure data can include some uncertainties. In other words, left censored data, interval censored data and right censored data can be available in data set. Therefore, effects of censored data for failure distribution parameters can be investigated in future works.

REFERENCES

Abbasi, B., & Jahromi A.H.E., & Arkat, J., & Hosseinkouchack, M. (2006). Estimating the parameters of Weibull distribution using simulated annealing algorithm. *Applied Mathematics and Computation, 183(2006),* 85-93. doi:10.1016/j.amc.2006.05.063

Akdağ, S. A., & Güler, Ö. (2008, Dec). Weibull Dağılım Parametrelerini Belirleme Metodlarının Karşılaştırılması. Paper presented at the *UTES'2008 Symposium: VII. Ulusal Temiz Enerji Sempozyumu.*

Chu, Y.K., & Ke, J.C. (2012). Computation Approaches for Parameter Estimation of Weibull Distribution. *Mathematical and Computational Applications, Vol. 17, No. 1,* 39-47.

Dhillon, B.S. (2002). *Engineering Maintenance*, A Modern Approach, CRC PRESS

Hung, W.L., & Chang, Y.C. (2011). Comparison between method of moments and entropy regularization algorithm applied to parameter estimation for mixed-Weibull distribution. *Journal of Applied Statistics, 38(12),* 2709-2722. http://dx.doi.org/10.1080/02664763.2011.567252

Kaplan, Y.A. (2016). The Evaluating of Wind Energy Potential of Osmaniye Region with Using Weibull and Rayleigh Distributions. *Süleyman Demirel University Journal of Natural and Applied Sciences, Volume 20, Issue 1,* 62-71. doi: 10.19113/sdufbed.63806

Köksal, M. (2007). *Bakım Planlaması*, Seçkin Yayıncılık.

Kurban, M., & Kantar, Y.M., & Hocaoğlu, F.O. (2005). Statistical Analysis of Wind Speed Power Densities Using Weibull Distribution. *AKU-Journal Of Science, 7(2),* 206-218.

Kurz, D., & Lewitschnig, H., & Pilz J. (2014). Advenced Bayesian Estimation of Weibull Early Life Failure Distributions. *Quality and Reliability Engineering International, 30,* 363-373. doi: 10.1002/qre.1577

Life Data Classification, <http://reliawiki.org/index.php/Life_Data_Classification>, Date: 03.06.2015.

Razali, A.M., & Al-Wakeel, A. (2013). Mixture Weibull distributions for fitting failure times data. *Applied Mathematics and Computation, 219(2013),* 11358-11364. http://dx.doi.org/10.1016/j.amc.2013.05.062

Tan, Z. (2008). A new approach to MLE of Weibull distribution with interval data. *Reliability Engineering and System Safety 94(2009),* 394-403. doi: 10.1016/j.ress.2008.01.010

Zeytinoğlu, F.Ç. (2009). *Comparison of Statistical Estimation Methods for the Scale and Shape Parameters of the Weibull Distribution*. Istanbul Commerce University Journal of Social Sciences, Volume 8, Issue 15, 73-87.

Zhang, T., & Dwight R. (2013). Choosing an optimal model for failure data analysis by graphical approach. *Reliability Engineering and System Safety 115(2013),* 111-123. http://dx.doi.org/10.1016/j.ress.2013.02.00

OVERALL ORGANIZATIONAL PERFORMANCE: A NOTE ON FIRMS OPERATING IN THE WESTERN BALKANS REGION

Ivan Stefanović*[1], Nenad Marčetić[2]
[1]Business Processes and Procedures Department Head, Vojvodjanska Bank, NBG Group, Novi Sad
[2]Continuous Improvement and QEMS Specialist, Cooper Standard, Sremska Mitrovica
*Corresponding author, e-mail: ivan.stefanovic@voban.groupnbg.com

Abstract: *Most firms in the Western Balkans region manage only some portion of their performances due to the lack of understanding of the overall organizational performance concept. The result is an empty space that represents a potentially tremendous opportunity for managers wishing to fill the gap between their firms' current and desired level of performance. The paper starts with a theoretical background aimed to increase the practitioners' understanding of performance systems and management concept by integrating three levels of organizational performances into one comprehensive framework. This literature review sets the stage for empirical investigation conducted in 22 firms in the 5-years period that showed that, even though all the firms from the sample have some sort of performance system at strategic level, operational and individual level of performance are mainly not covered. Therefore, most of the firms are not in the position to effectively and systematically manage their performances, which is a necessary condition for their long term development. In order to remedy this situation, management will have to increase the awareness about the concept of the overall organizational performance in their firms, develop a proper performance management methodology, and bridge the gap in knowledge and skills related to performance management that resides in their employees.*

Keywords*: performance management, process, indicator, measurement, Western Balkans*

1. INTRODUCTION

Survival of firms depends on their overall performance. It is no longer viable to focus on some specific aspect of performance, such as production performance, financial performance, or sales performance. In order to stay competitive over the long run, firms must take a much broader view. They have to start tackling the performance issue holistically. More specifically, they need to grasp the complexity of their business, take a multidimensional perspective on performance, define various measures, conduct measurements, acquire and analyze the results, and perform specific actions accordingly. Thus, a lot of work is ahead of managers willing to manage the overall performance of their firms.

However, one must recognize the difficulties on this journey. One of the biggest roadblocks is the fact that it is not possible to measure social phenomena, such as those considering firms and their overall performances, with anything close to accuracy that characterizes the field of science. In line with this argument, Wholey (1996) states that performance is not an objective reality waiting to be measured and evaluated, but rather a socially constructed reality that exists in people's minds. Therefore, designing and implementing a performance management system within a firm is not an easy task. It is a very complex and time consuming effort that requires both imagination and analytical skills.

Considering these facts, it is no wonder Taticchi (2008) claims that interest in performance management has notably increased over the last 20 years (cited in Taticchi, Tonelli & Cagnazzo, 2010). Nevertheless, even though results of impact of this increased interest are mixed, it might be argued that its practical implications have not yet reached the benefits expected. For example, the results of a survey of 278 organizations from 15 countries, out of which about two-thirds are multinational corporations, showed that around 91% of them have established some form of performance management system. Survey findings revealed that organizations with formal and systematic performance management systems are 51% more likely to outperform their competitors regarding financial outcomes and 41% regarding additional outcomes including customer satisfaction, employee retention, and other important metrics (Casio, 2006). On the other hand, a public survey conducted recently by Deloitte revealed that more than half of the executives questioned (58%) believe that their current performance management approach drives neither employee engagement nor high performance (Buckingham & Goodall, 2015). These findings show that, even though some level of success with performance systems implementation is evident, current performance management systems have to be reexamined and modified in order to serve their purpose in a more holistic manner.

The purpose of this paper is to provide evidence to the managers in the Western Balkans about the existence of a wide gap between their practice (performance systems currently employed by their firms) and the overall organizational performance system. Therefore, its goal is twofold: (1) to depict the framework for overall organizational performance system in order to help managers understand this concept and benefits of its implementation (achieving this goal might be of interest to practitioners working worldwide), and (2) to set out to explore the current conditions of performance management in firms operating in Western Balkans region (the part of paper dedicated to this goal might be more interesting to practitioners working in Western Balkans). The paper starts with theoretical background in which the concept of performance management and overall organizational performance system is explained. The next part depicts the research conducted in firms operating in Serbia, FYR Macedonia, and Bosnia and Herzegovina between 2011 and 2015, as well as its results. The section considering practical guidelines regarding implementation of an overall organizational performance system in the firms follows. The paper ends with conclusion remarks.

2. THEORETICAL BACKGROUND

Firm performance indicates the quality of the firm's continuous co-alignment with the environment (Chakravarthy, 1986). On the other hand, performance management is seen as a tool that helps management improve organizational performance (Aguinis & Pierce, 2008) by providing them more control over a firm, which is in line with de Waal's (2010) argument that there is a clear and strong relation between organizational performance and the attention given to management control.

Performance management system may be regarded as a set of formal, information-based routines and procedures managers use to maintain or alter patterns in organizational activities (Simons, 2000). This system focuses on conveying financial and non-financial information that influence decision making and managerial action (de Wall, 2010). It is a balanced and dynamic system that enables support of decision-making processes by gathering, elaborating and analyzing information (Neely, Adams & Kennerley, 2002). The term "balance" refers to the need of using different perspectives and measures with both leading and lagging indicators that, tied together, provide a holistic view of an organization (Kaplan and Norton, 1992; Kaplan and Norton, 1996). On the other hand, "dynamicity" refers to the need of developing a system that continuously monitors the internal and external context and reviews objectives and priorities (Bititci et al., 2000).

Performance-based management includes developing a reasonable level of agreement on goals and strategies for achieving goals, as well as developing performance measurement systems that provide data that are sufficiently complete, accurate, and consistent to document performance and support decision making (Wholey, 1999). Performance may focus on inputs (money, assets, workforce, etc.), processes itself or some of their parts or activities (lead time, cycle time, etc.), or outputs (products or services delivered to the customers). It may focus on a variety of complex indicators that put different indicators in some sort of relations, such as efficiency or productivity which relate output to input. Performance may also focus on intermediate outcomes such as client satisfaction or end outcomes such as environmental quality or health status (Wholey, 1999). On the other hand, Simons (2000) argues that performance management systems cannot be designed without taking into consideration human behavior. Thus, it is not enough to observe only the hard elements of performances, i.e. what is being done, but also the soft components, i.e. the manner in which it is done.

That being said, no wonder that in the late 1980s and early 1990s dissatisfaction with traditional backward looking accounting based performance measurement systems led to the development of more complex, holistic and balanced measurement frameworks (Bourne et al., 2000). The need for an integrated approach to performance management based on systems thinking (Senge, 1990) was recognized. Instead of an isolated approach to one dimension of performance, the focal point became an integration of all components of the system and mapping the relationships between them (Brudan, 2010).

In order to secure its viability over the long run, the majority of firms need a management system based on overall organizational performance. Lawrence and Lorsch (1967) further elaborate this argument by stating that "it is clear that total organizational performance is... related to achieving the degree of integration between subsystems required for the overall organizational task of coping with the external environment." (p. 11) Therefore, the task of designing, implementing and managing overall organizational performance system seems quintessential for the success of any firm.

Overall organizational performance system is a very complex network of various indicators organized into three basic levels: strategic, operational and individual (cf. Brudan, 2010). At strategic level, performance management deals with the achievement of overall organizational goals. This level is crucial for the long term

adaptation to the environment, especially in situations in which management ought to pay attention to a large number of variables in the environment and their volatile dynamics (cf. Stefanović, Prokić & Vujović, 2012). Performance management at operational level covers end-to-end processes, i.e. the manner in which the value is being created for the end-users. This level acknowledges the processes as the driving force of any firm (Hammer & Champy, 1993), while adopting the customer's point of view (Davenport, 1994). The third level of performance is oriented on individuals. It covers the manner in which their day-to-day activities are being performed and the results achieved.

These three levels of performance ought to be seen as inextricably intertwined parts of the same system, even though in practice this is rarely the case. "Practice shows that communication and integration between the three levels of organizational performance is limited... Management does not see performance management as an integrated discipline used at various organizational levels, but as a subcomponent of strategic, operational and HR management respectively. An integrated approach, linking together all levels of performance management, becomes a necessity for both research and practice to facilitate the understanding and usage of performance management systems... This proposed integrated view to performance management has the potential to assist individuals and organizations to better understand and align these levels and create a complete, holistic picture of performance that outlines the relationship between organizational and individual performance." (Brudan, 2010, pp. 117-119). Having in mind the importance of having one integrated and overall performance system in place, we will elaborate on each of the three performance levels.

2.1. Strategic performance level

Strategic level emphasizes the firm's relationships with its environment and the basic "skeleton" of the major functions that comprise the firm (Rummler & Brache, 2013). In other words, strategic level is focused on strategic goals, i.e. the goals covering the whole firm as a part of its business strategy. These goals are then broken down to subgoals for each function. Only by taking a holistic stand and viewing the firm as a whole, its subgoals will not permit the optimization of the functional silos. Therefore, each subgoal ought to be derived from one of the strategic goals and be aligned with it.

The performances at this level are being measured by the percentage of achievement of strategic goals and subgoals. Only after the measurement results are obtained and analyzed, the discussion regarding further actions may start. Of course, this discussion must incorporate the results obtained from the other two levels of performance as well. Considering strategic level solely will not provide comprehensive information, which may jeopardize the effectiveness of further actions.

Strategic goals and accompanying functional subgoals may only be achieved through the hard work being done by every employee of the firm. In other words, strategic performance level needs to be integrated with other levels of performance in order to establish and manage the overall performance management system. Only in this way will strategic performance system gain its full relevance.

2.2. Operational performance level

Focusing on strategic level performance by itself will not provide a significant level of understanding of how the firm actually works. For this to happen, on must probe deeper into the firm's "skeleton". This deeper level will show the processes, which may be understood as the manner in which a firm does its work, i.e. the set of activities it pursues to accomplish a particular objective for a particular customer, either internal or external (Davenport, 2005). Operational performance level relates process performance and the customer satisfaction level resulting from it (Davenport, 1994). Taking the process standpoint in firms is likely to yield certain benefits in terms of the overall performance (Davenport & Stoddard, 1994).

Rummler and Brache (2013) argue that a firm is only as effective as its processes. Therefore, operational performance level shows whether the work is done effectively and efficiently enough. The first step on this level is to identify all the processes being run within a firm and the relevant process performance indicators. These indicators are derived either from process goals or from the means of achieving these goals, i.e. subgoals. Each of these goals ought to be congruent with enterprise wide goals, take into account the behavior of the competitors and, last but not least, be in line with process stakeholders' interests. It is very important to emphasize that process performance represents a degree of stakeholder satisfaction, which is why process performance measurement ought to be focused on those individuals who have an interest in the business process. In order to develop this stakeholder-driven performance measurement system, stakeholders of the process have to be identified and their process-relevant goals clarified. Each group of stakeholders needs to be represented by an aspect or dimension of performance (Kueng, 2000).

Measuring the process performance is critical for process improvement and excellent process management is based on suitable performance measures (cf. Chiou-Shuei, 2014; Crandon & Merchant, 2006). Once there is a reasonable level of agreement on the meaning of performance, managers can obtain information on key aspects of process performance through performance measurement, that is, the periodic measurement of specific inputs, activities, outputs, intermediate outcomes, or end outcomes. Performance measurement includes both the collection and analysis of numerical data and less formal assessment of performance such as narrative assessment of the extent of progress toward defined goals (Wholey, 1999). "The main objective of process performance management system is to provide comprehensive and timely information on the performance of business processes. This information can be used to communicate goals and current performance of a business process directly to the process team, to improve resource allocation and process output regarding quantity and quality, to give early warning signals, to make a diagnosis of the weaknesses of a business process, to decide whether corrective actions are needed and to assess the impact of actions taken." (Kueng, 2000, p. 72).

2.3. Individual performance level

Stopping at the operational level would hinder the understanding of performance on the most granular level: an employee and the work he or she performs. Rummler and Brache (2013) argue that "performance can be improved only if jobs and performers are analyzed in an overall performance context." (p. 62) Therefore, focusing on each individual within a firm is an essential task if one wants to gain a holistic view on performance.

Performance management system on the level of employees can be based on a consideration of behavior (how work is being done) or results (outcomes of work). Of course, combination of both is possible as well (Aguinis & Pierce, 2008). When it comes to work, Rummler and Brache (2013) advocate so-called "Human Performance System" (HPS), which may be one of the best approaches for managing the performance on individual level. TPS contains the following elements (Rummler & Brache, 2013): (1) input in terms of task support, (2) performer with its skills, knowledge and capacity, (3) output in terms of performance specifications, (4) consequences of reaching or not reaching the desired performance, and (5) feedback in terms of information about the performer's performance. Each of these elements is being permanently assessed for each employee within a firm.

TPS approach implicitly states that performance problems occurring at individual level may only sometimes be attributed to the employee. Rather, it supports the claim of W. Edwards Deming that employees are responsible for only 15 percent of the problems, and the system for the other 85 percent, which is the responsibility of management (Walton, 1986).

3. RESEARCH METHODOLOGY

The research question this paper is trying to answer is the following: Where do firms operating in the Western Balkans region stand on the road toward implementing the overall organizational performance system? The starting premise that helped authors embark on this journey is that most firms in Serbia and surrounding countries do not have an integrated, holistic system of measuring their performances on a regular basis. Instead, they usually rely on a set of financial measures based on traditional accounting systems. In other words, there is some sort of natural inclination to use the conventional financial data such as: profit, revenue, change in profits, change in revenues, percentage of new products in total sales, and so forth (cf. Lawrence & Lorsh, 1967, p. 25-26). This approach, besides measuring only one dimension of firm performance, focuses on lagging indicators and looks at the performance already achieved, i.e. retroactively. Non-financial aspects of firm performance, such as customer satisfaction or job satisfaction still play a modest role (cf. Eccles, 1991).

Authors' experience is that management tool mostly used in firms operating in Western Balkans is the quality management system certification according to ISO 9001 requirements, which somewhat guarantees that firms identify and execute their business processes in a specified and controlled way. Following this reasoning, the authors seized the opportunity to investigate the current state of the performance systems in firms operating in Western Balkans region during the time one of the authors spent as a management systems consultant and auditor. While running these consultancies and audits, this author acquired the relevant information on numerous firms, which make the majority of the sample collected. The other author has brought his own insights and relevant information from several other firms while working for them. Even though the sample of firms is selected on the "easy to obtain" criterion, thus resulting in the convenience

sample, authors believe it is still indicative for the current state of the whole population of firms in the region, which might be confirmed by some other research that would use the representative sample.

This research was carried out in the period between 2011 and 2015 on a sample of 22 firms operating in three countries of the Western Balkans region (Serbia, Bosnia and Herzegovina, and FYR Macedonia). All the firms in the sample have more than 250 employees, which classifies them in the group of large firms according to the current Accounting Law (Službeni glasnik, 2013). Only large firms have been taken into account because their scale allows them to recognize the need and have the necessary resources for implementing performance management systems.

The names of the firms in the sample will remain undisclosed due to confidentiality reasons. However, some details on the structure of the sample ought to be presented. First of all, the number of firms per country (Serbia, Bosnia and Herzegovina, and FYR Macedonia) ought to be revealed. Table 1 shows these numbers.

Table 1: Number of firms per country of their operations

Country of firm's operations	Serbia	Bosnia and Herzegovina	FYR Macedonia	Total number of firms
Number of firms per country	15	2	5	22

Secondly, the relevant data about each firm in the sample have been obtained in one year only during the period 2011-2015. Table 2 indicates from how many firms per year during this period the data have been obtained.

Table 2: Number of firms from which the data have been obtained per year

Year of data collection	2011	2012	2013	2014	2015	Total number of firms
Number of firms per year	5	4	6	1	6	22

Thirdly, there are differences in the number of employees per firm, which is why four categories have been identified and firms have been classified accordingly. This is shown in Table 3.

Table 3: Number of firms per their size in terms of employees

Number of employees	251-500	501-1000	1001-2000	≥2001	Total number of firms
Number of firms in the category	10	8	3	1	22

Finally, the firms in the sample operate in various industries and Table 4 indicates the number of firms per industry. For the purpose of industry classification, NACE classification of economic activities has been used (Eurostat, 2008). Even though some of the firms in the sample perform activities in more than one industry, which means they have more than one code, only the code for principal industry has been used.

Table 4: Number of firms per industry

Section	**Industry title**	**Number of firms**
B	Mining and quarrying	3
C	Manufacturing	10
F	Construction	3
H	Transportation and storage	1
J	Information and communication	2
K	Financial and insurance activities	1
N	Administrative and support services activities	1
P	Education	1
Total number of firms		22

After explaining the manner in which the sample has been obtained, as well as the structure of the sample, the criteria for assessing whether a firm has performance system implemented and at what level the performance is being managed ought to be depicted. In other words, what have the authors done with the collected data? How have they assessed if the firm has implemented performance system at some level?

The criteria for stating that a firm has some form of performance system have been defined as follows:

- Strategic performance level exists if at least 50% of the organizational units at the highest level of hierarchy (usually functions or divisions) have formally defined some sort of metrics (usually in the form of goals and objectives) and take obvious actions toward achieving it.
- Operational performance level exists if at least 50% of all the processes being run in the firm are formally identified and mapped, as well as have some sort of metrics established (usually in the form of KPIs with the associated targets) and obvious actions toward achieving it are being taken.
- Individual performance level exists if for at least 50% of positions (not employees/performers) there is some sort of metrics established that takes into account the performer with his/her behavior (how work is being done) and/or results (outcomes of work), as well as a system surrounding and influencing the performer's performance (adequate inputs, timely feedback, etc.) with the targets defined and obvious actions toward achieving them are being taken.

After depicting the firm sample details and explaining the criteria for identifying whether a firm has a performance system in place at some of the three levels, we will now turn to the results obtained and discuss their implications.

4. RESULTS AND DISCUSSION

Results obtained on the sample of 22 firms operating in three countries in the Western Balkans region are shown in the Table 5.

Table 5: Number of firms with established performance systems per three levels

The level of performance	Strategic	Operational	Individual
Number of firms with established performance system	22	12	1

Even though these results were somewhat expected, what came as a surprise was the fact that more than half of the firms in the sample had some sort of performance system on operational level. Based on their experience, both authors believe that the vast majority of firms operating in Serbia and surrounding countries have not yet completed a proper process identification and mapping, which is a necessary precondition for any kind of process performance system development. In other words, the results obtained at the operational level seemed misleading.

This is why further insights had to be developed. Since it was not possible to go back to the firms from the sample and conduct further investigations, authors have decided to interview some of the people working at those firms. Very quickly, a plausible explanation has been offered.

A number of firms for which the results showed they had operational performance systems in place were actually making those systems only for the purpose of the management systems certifications (e.g., ISO 9001, ISO 14001, BSI OHSAS 18001, etc.). Thus, these systems were actually nonexistent except on paper. Other firms from this sample had these systems in place, only not for the purpose of performance improvement, but rather merely for making more or less complex management reports, while the improvement actions would usually be omitted. It is interesting that the reason for making these reports was often unknown or found in some request from management in the past, but has not been assessed in the light of changing circumstances since then, which indicates the high level of organizational inertia (cf. Stefanović et al., 2014).

This kind of logic for making performance systems resulted in two more negative aspects. First, the performance indicators were not designed in order to reflect the needs of the customer and the accompanying process logic, which is why they were made static, i.e., they were not subjected to the changes in order to reflect the numerous shifts in the environment. Secondly, there was no alignment between the performance indicators on strategic and operational level (the results showed that only one firm had performance system established at individual level). There was not even an alignment between

performance indicators on the same level due to the fact that each organizational unit was usually developing its own indicators without taking the perspective of the whole firm or end-to-end processes.

This situation led the authors to the conclusion that true performance systems did not exist at operational level in majority of firms from the sample. Their processes were not being managed systematically through a set of performance indicators. Since performance systems did not exist at individual level either, it became clear that these firms had performance systems established only at the strategic level. On this level, performance indicators were being defined, measurements conducted and improvement actions taken.

5. RECOMMENDATIONS FOR PRACTITIONERS

The results from the investigation depicted in the previous sections show a low level of commitment in the firms operating in Western Balkans toward performance systems design and implementation. Taking this into account, authors can only assume this is attributed to the lack of general understanding of the performance system concept. Therefore, it is clear that something has to be done in order to remedy this situation if these firms are to thrive in the future marketplace.

The path toward designing and implementing the overall performance system is not an easy one. It must start with increasing the level of understanding of all key stakeholders about the concept of performance system and the benefits of its implementation. After all the stakeholders are acquainted with this and their approval is obtained, the work on designing the performance system may begin.

The design effort ought to start on the strategic level with the strategic goals. These goals are then broken down to subgoals for each function or division. After that, the subgoals are treated as targets that must be met by the processes being run within a firm. The processes are being mapped and performance indicators defined, starting from the process targets and moving backwards toward the upstream activities. Of course, each process performance indicator ought to have its own accompanying target in line with the process targets. The next step involves positions in charge of the activities comprising these processes. After identifying the responsibilities of each position within the processes in stake, performance indicators are being defined reflecting the performer's behavior and results, as well as a system surrounding and influencing the performer's performance (adequate inputs, timely feedback, etc.).

Only the performance system that links performance indicators from the top of a firm to its operating core and spreads throughout an entire organization may provide significant potential for radical performance improvement. Thus, every individual in a firm has to be fully covered by the performance system, which means that performance of every employee will be connected to the performance of every other employee. The resulting network of performances represents the system for measuring and improving the overall organizational performance.

Development, implementation and management of an overall performance system requires: (1) sound measures that ensure the right things are being monitored, (2) a total measurement system, not a collection of unrelated and potentially counterproductive measures, and (3) performance management process that converts the data provided by the measurement system into intelligent action (Rummler & Brache, 2013).

In line with this, it is useful to note that, while designing a performance system in a firm, one must take into account the concepts of business process management (BPM) and business intelligence (BI). BPM is focused on improving a firm performance by managing and optimizing its processes (cf. Panagacos, 2012), while BI brings value to managerial decisions by allowing them to easily identify, collect and interpret large volumes of data (cf. Rud, 2009). These concepts ought to be linked to performance management design from the start: BPM in the area of process identification and mapping, BI in the area of collecting the right data, their measurement and analysis, and BPM again in the process optimization phase. This is being emphasized due to the results of a research conducted in one of our neighboring countries by Vukšić, Bach and Popovič (2013). These results show that the usage of BPM and BI is not orchestrated within the framework of performance management.

5. CONCLUSION

Firms in Western Balkans region, specifically in Serbia, Bosnia and Herzegovina, and FYR Macedonia are on the very beginning of the road toward performance management. Even though some sporadic attempts have been made in this direction, there is a huge amount of work still left to be done. First of all, there is a need to increase the awareness about the concept of the overall organizational performance as a tool for achieving higher states of competitiveness. Secondly, a proper performance development and

implementation methodology has to be taken into account and tailored to suit the needs and possibilities of each individual firm. Finally, the gap between required and current level of the employees' knowledge and skills related to performance management ought to be identified and bridged.

Management in firms operating in Western Balkans must embrace the fact that if they wish their firms to continue to grow and develop in the long run, they will have to be able to manage the overall performance of their firms, not just some part of it as has been the case until now.

REFERENCES

Aguinis, H., & Pierce, C. A. (2008). Enhancing the Relevance of Organizational Behavior by embracing Performance Management Research. *Journal of Organizational Behavior*, 29, 139-145.

Bititci, U. S., Turner, T., & Begemann, C. (2000). Dynamics of Performance Measurement Systems. *International Journal of Operations & Production Management*, 20, 692-704.

Bourne, M., Mills, J., Wilcox, M., Neely, A., & Platts, K. (2000). Designing, Implementing and Updating Performance Measurement Systems. *International Journal of Operations & Production Management*, *20*(7), 754-771.

Brudan, A. (2010). Rediscovering Performance Management: Systems, Learning and Integration. *Measuring Business Excellence*, *14*(1), 109-123.

Buckingham, M., & Goodall, A. (2015). Reinventing Performance Management. *Harvard Business Review*, April, 40-50.

Casio, W. F. (2006). Global Performance Management Systems. In Bjorkman, I. & Stahl, G. (Eds.), *Handbook of Research in International Human Resources Management*, 176-196. London, UK: Edward Elgar Ltd.

Chakravarthy, B. S. (1986). Measuring Strategic Performance. *Strategic Management Journal*, *7*(5), 437-458.

Chiou-Shuei, W. (2014). Measuring Performance of Management Process: Efficiency, Capability, Cost and Maturity. *Human Systems Management*, 33, 171–179.

Crandon, D. S., & Merchant, K. A. (2006). Principles to Guide the Development and Use of Effective Performance Measures. *Performance Improvement Journal*, *45*(2), 17-22.

Davenport, T. H. (1994). Managing in the New World of Process. *Productivity & Management Review*, *18*(2), 133-147.

Davenport, T. H. (2005). The Coming Commoditization of Processes. *Harvard Business Review*, June, 100-108.

Davenport, T. H., & Stoddard, D. B. (1994). *Reengineering: Business Change or Mythic proportions? MIS Quarterly*, *18*(2), 121-127.

de Waal, A. A. (2010). Performance-Driven Behavior as the Key to Improved Organizational Performance. *Measuring Business Excellence*, *14*(1), 79 – 95.

Hammer, M., & Champy, J. (1993). Reengineering the Corporation: A Manifesto for Business Revolution. *New York*, NY: Harper Business.

Eccles, R. (1991). The Performance Measurement Manifesto. *Harvard Business Review*, 69, 131-138.

Eurostat (2008). NACE Rev. 2: Statistical Classification of Economic Activities in the European Community. *Luxembourg: Office for Official Publications of the European Communities*.

Neely, A., Adams, C., & Kennerley, M. (2002). The Performance Prism: The Scorecard for Measuring and Managing Stakeholder Relationship. *London: Prentice Hall*.

Kaplan, R. S., & Norton, D. P. (1992). The Balanced Scorecard: Measures that Drive Performance. *Harvard Business Review*, January-February, 71-79.

Kaplan, R. S., & Norton, D. P. (1996). Using the Balanced Scorecard as a Strategic Management System. *Harvard Business Review*, January-February, 75-85.

Kueng, P. (2000). Process Performance Measurement System: A Tool to Support Process-Based Organizations. *Total Quality Management*, *11*(1), 67-85.

Lawrence, P. R., & Lorsch, J. W. (1967). Differentiation and Integration in Complex Organizations. *Administrative Science Quarterly*, *12*(1), 1-47.

Panagacos, T (2012). The Ultimate Guide to Business Process Management: Everything You Need to Know and How to Apply It to Your Organization. *Theodore Panagacos*.

Rud, O. P. (2009). Business Intelligence Success Factors: Tools for Aligning Your Business in the Global Economy. *Hoboken,* NJ: John Wiley & Sons, Inc.

Rummler, G. A., & Brache, A. P. (2013). Improving Performance: How to Manage the White Space on the Organization Chart. *San Francisco*, CA: John Wiley & Sons, Inc.

Senge, P.M. (1990). The Fifth Discipline: The Art and Practice of the Learning Organization. *New York*, NY: Currency Doubleday.

Simons, R. (2000). Performance Measurement and Control Systems for Implementing Strategy: Text and Cases. *Upper Saddle River*, NJ: Prentice Hall.

Službeni glasnik (2013). Zakon o računovodstvu. *Službeni glasnik* RS, 62/2013.

Stefanović, I., Prokić, S., Săvoiu, G., & Simăn, I. I. (2014). Building a Conceptual Model of Routines, Capabilities, and Absorptive Capacity Interplay. *Management – Journal for Theory and Practice of Management, 19*(73), 5-16.

Stefanović, I., Prokić, S., & Vujović, S. (2012). The Organizational Environment Dimensions Revisited: Analysis of the Contemporary Context. *Transformations in Business & Economics*, *11*(1), 124-138.

Taticchi, P. (2008). Business Performance Measurement and Management: Implementation of Principles in SMEs and Enterprise Networks. *PhD thesis*, Perugia: University of Perugia.

Taticchi, P., Tonelli, F., & Cagnazzo, L. (2010). Performance Measurement and Management: A Literature Review and a Research Agenda. *Measuring Business Excellence*, *14*(1), 4-18.

Vukšić, V. B., Bach M. P., & Popovič, A. (2013). Supporting Performance Management with Business Process Management and Business Intelligence: A Case Analysis of Integration and Orchestration. *International Journal of Information Management*, 33, 613-619.

Walton, M. (1986). The Deming Management Method. *New York*, NY: The Berkley Publishing Group.

Wholey, J. S. (1996). Formative and Summative Evaluation: Related Issues in Performance Measurement. *American Journal of Evaluation*, *17*(2), 145-149.

Wholey, J. S. (1999). Performance-Based Management: Responding to the Challenges. *Public Productivity & Management Review*, *22*(3), 288-307.

IMPROVING EFFICIENCY OF ENGINEER-TO-ORDER OPERATIONS THROUGH LEAN IMPLEMENTATION: EMPIRICAL RESEARCH

Ivan Tomašević*[1], Dragoslav Slović[1], Dragana Stojanović[1]
[1]University of Belgrade, Faculty of Organizational Sciences
*Corresponding author, e-mail: tomasevici@fon.bg.ac.rs

Abstract: *Lean applicability in ETO operations has been questioned by many authors. The results of recent research state that more empirical evidence is needed in order to rule in favor or against lean applicability in ETO environment. This paper presents results of action research, where efficiency of ETO company was improved through lean implementation. Lead times were reduced and delivery reliability was improved, thus adding to the fact that lean can be used for improving efficiency of ETO operations. Lean was implemented through tool-agnostic approach, where implementation was based on laws and principles that define lean, rather than specific tools. This approach provides implementation universality, and takes into account characteristics of specific manufacturing environment.*

Keywords*: engineer-to-order (ETO), lean, efficiency improvement, operational performance, empirical research*

1. INTRODUCTION

The emergence and popularization of lean is considered as one of the most important steps in the development of operations management (see e.g. Hines et al., 2004; Holweg, 2007). Lean can be defined as a continuous effort aimed at eliminating waste and sources of waste. Lean has helped many manufacturing companies around the world to realize significant gains in efficiency (see e.g. Womack et al., 1990; Womack & Jones, 1996; Slović et al., 2015). Still, most examples of efficiency improvement come from manufacturing environment similar to the one in which lean was originally developed in terms of product variety, volumes produced, and component assembly nature (i.e. repeated manufacturing of limited array of similar products in relatively high volumes). Some authors state that, in the future, lean research will abandon traditional manufacturing environment and focus more on areas such as high-mix/low-volume operations, thus moving from prescriptive application to contingency-led approach (Hines et al., 2004; White & Prybutok, 2001; Papadopoulou & Özbayrak, 2005). Engineer-to-order (ETO) operations represent high-mix/low-volume environment that is considered under-researched regarding lean implementation (Hines et al., 2004). Lean strategies have been proposed in ETO sector. However, characteristics of ETO sector might differ significantly from the ones typically found with low-mix/high-volume manufacturers, and extent to which lean practices are suitable for ETO operations has been questioned (Cooney, 2002). Empirical evidence in support of or against lean implementation in ETO operations are fairly limited, any contemporary research suggests that more empirical evidence is needed in order to test the applicability of lean principles in ETO environment (Gosling & Naim, 2009; Naim & Gosling, 2011).

This paper presents the results of empirical research, where lean has been implemented in a company that represent typical ETO manufacturer, supporting the stance that efficiency of ETO operations can be improved through lean implementation. The reminder of the paper is organized as follows: literature review regarding lean, peculiarities of ETO operations, and lean implementation in ETO operations is presented in Section 2; research design is presented in Section 3; the results of empirical research are presented in Section 4; discussion and conclusion follows in Section 5.

2. THEORETICAL BACKGROUND

2.1. Lean manufacturing

Lean manufacturing originated in Toyota after Second World War as a result of scarcity of resources and intense domestic competition on automobile market (Hines et al., 2004; Hopp & Spearman, 2008). Toyota developed a system (Toyota Production System – TPS) that was able to produce greater variety of products with lesser inventory, human effort, investments, and defects (Womack et al., 1990). TPS was developed as an alternative to Ford production system, and often has been seen as a counter-intuitive approach that

differs significantly from then dominant mass production (Womack et al., 1990). It was developed and applied under the leadership of Taiichi Ohno (1988), and additionally documented by the likes of Monden (1983) and Shingo (1989).

Monden (1983) is largely responsible for bringing TPS to western audience. His book described in details Just-In-Time (JIT) manufacturing as one of the pillars of TPS (the other one being autonomation, or *jidoka*). Term 'lean manufacturing' was coined during the International Motor Vehicle Program (IMVP) research, which was aimed at bridging the performance gap between Western and Japanese car manufacturers. Waste elimination was recognized as a central role of lean manufacturing (Bhamu & Sangwan, 2014), where waste is any system input (transformed resources, transforming resources) that is not transformed into a system output (fulfilled customer demand, this is neither unfulfilled nor exceeded) just-in-time. Womack & Jones (1996) described lean as an antidote for waste, and devised 5 lean principles aimed at eliminating waste: value, value stream, flow, pull, and perfection. Lean was deemed to be universally applicable to wide array of business environments (Womack & Jones, 1996). However, many authors criticize lean for its lack of applicability in operations that differ significantly from low-mix/high-volume environment that lean was developed in (Cusumano, 1994; Hines et al., 2004). Tool based implementation, car-manufacturing focus, and inability to handle variations in demand were recognizes as lean's main weaknesses (Hines et al., 2004).

2.2. Lean implementation in ETO operations

ETO operations are considered as operations where decoupling point (stock holding point that separates the part of the supply chain that responds directly to the customer from the part of the supply chain that uses forecast planning; see e.g. Portioli-Staudacher & Tantardini, 2012) is located early in the supply chain, typically at the design stage (Gosling & Naim, 2009). It refers to the type of operations where customer actively collaborates in product design, in order to develop and manufacture a product that meets functional requirements of the customer (Birkie & Trucco, 2016). The output of ETO operations is highly customized product that may be a result of modified past design or an entirely new design for every customer (Portioli-Staudacher & Tantardini, 2012). The demand is usually unstable and unpredictable. ETO operations might be associated with large, complex project environments such as construction and capital goods that require extremely high work content and low volumes (Gosling & Naim, 2009; Potrioli-Staudacher & Tantardini, 2012). However, large proportion of ETO operations is conducted by small machine shops, where customer requires design and production of highly customized products in relatively low volumes. These types of operations are often labeled as non-repetitive operations (see e.g. White & Prybutock, 2001). ETO operations are characterized by a high level of dynamism and complexity that create environment that is heterogeneous and unpredictable (Birkie & Trucco, 2016). Traditionally, short concept-to-delivery time and high delivery reliability are deemed to be key priorities for ETO companies, rendering them order winning characteristics in addition to quality (Amaro et al., 1999; Portioli-Staudacher & Tantardini, 2012). Price is considered to be of secondary importance, and is usually seen as order qualifying characteristic (Amaro et al., 1999; Birkie & Trucco, 2016).

Lean is often used to address problems with long lead times and unreliable delivery in repetitive manufacturing environment with stable and predictable demand. This is why there's a rising interest in lean implementation in ETO companies. Although lean has been suggested as a mean for efficiency improvement in non-repetitive manufacturing, evidence about lean implementation in ETO operations is scarce. Many authors state that lean implementation requires stable and predictable demand, which is unlikely situation in ETO operations (Hendry & Kingsman, 1989; Hüttmeir et al., 2009). Some of recognizable lean tools (such as work cells, takt time, supermarket pool, etc.) are deemed to be inapplicable or even undesirable in ETO environment (Hendry & Kingsman, 1989; Cooney, 2002; Hopp & Spearman, 2008).For example, straightforward and effective tool such as value stream map might be difficult to implement since product flows are often interlaced, resources are being shared, and cycle times differ between different products. Quality at the source might be hard to obtain, since products are highly customized, making it hard to learn from past mistakes. Demand variability, both in volume and mix, makes it hard to level the production in way it is done in environment with stable demand (Lander & Liker, 2007; Stump & Badurdeen, 2009). This might lead to ETO managers questioning the importance that lean might have for non-repetitive manufacturers (Jina et al., 1997). Difficulties in lean implementation might have several causes: (i) knowledge of lean implementation in ETO operations is not as structured and systematized as in repetitive manufacturing; (ii) managers fail to recognize contextual factors of ETO operations, and try to copy lean practice from repetitive manufacturing; (iii) managers fail in understanding underlying principles of lean, and focus on tools; and (iv) there is no unique framework that will guide lean implementation in ETO environment. Many researchers state that evidence on lean applicability in ETO environment is yet to be found, suggesting that more empirical research is needed to support the effects that lean might have on efficiency of ETO operations (Gosling & Naim, 2009; Birkie & Trucco, 2016).

3. RESEARCH DESIGN

The main research question in this paper is:

Can lean improve efficiency of ETO operations?
This section presents the research design established in order to answer the research question. Research design is presented in two subsections. First subsection gives a description of a case company, and discusses the rationale of using single case study approach. Second subsection discusses research approach and step taken in order to obtain the answer to the research question.

3.1. Case company: rationale and description

The research focuses on a single company. Using single company can be appropriate if it provides an opportunity to observe and analyze a phenomenon previously inaccessible to scientific investigation, and if longitudinal approach is taken, i.e. if functioning of case company is analyzed over a considerable period of time (Yin, 2013).

Company ALPHA (real name is obscured) is selected as a representative of ETO operations. The company produces Point-Of-Sale (POS) and Point-Of-Purchase (POP) products such as shelves, displays, overhand dispensers, kiosk displays etc. Most products are produced on an ETO basis, where company performs all steps of product realization, from design and engineering, prototyping, to manufacturing and delivery. The company serves a turbulent marking, and has to deal with demand variability both in production volume and mix. Demand is irregular and unpredictable, while products are mostly one of a kind in regard to design and characteristics. The company is subject to all kinds of external influences. Most of them are coming from customers, who are trying to enforce their orders as the most important ones. Product routings vary in sequence and length, although the flow of material is considered to be directed. Production volumes are relatively small, as are orders from suppliers, which makes company subject to supplier influence as well. During the initial interviews with managers and employees, it was concluded that company is not as efficient as it could be. Although there was a 'feel' that operations are not as efficient as they could be, the exact data were not collected or analyzed. For example, lead times were considered long, but precise data on average lead times were not readily available. In addition, the company had difficulties to adhere to promised due dates, but the data on percentage of lateness and average lateness was not available either.

3.2. Research approach and steps

To analyze the possibilities of efficiency improvement in ETO operations, a longitudinal case study was carried out. A considerable period of measurements was undertaken both before (baseline measurement) and during lean implementation (post-change measurement). The research involved cooperation between researchers, company managers and employees. Having that in mind, as well as the fact that research question 'relates to describing an unfolding series of actions over time in a given group, community or organization', the research can be further typified as action research, as a variant of case research (Coughlan and Coghlan, 2002). A process consultation model was chosen. Here, researchers help the clients inquire into their own issues, and actively participate in the design and implementation of the solution (Schein, 1999). A consistent approach was developed and well documented, so it can be followed by other researchers (Westbrook, 1995). Researchers' subjectivity was mitigated by including management and employee representatives in the research team. All decisions were made by consensus. In turn, employee subjectivity was mitigated by the presence of researchers. Research was conducted in three phases (Figure 1). First, base efficiency measurements were taken in order to enable researchers to understand the current situation, and to establish a baseline to which results obtained in later stages could be compared. Two types of measures were taken: (i) average lead time; and (ii) delivery reliability, measured through percentage of late orders and average lateness. Then, lean was introduced to the company. Afterwards, second set of efficiency measurements followed. Additional data were gathered from archival sources and semi-structured interviews with managers and employees.

Figure 1: Research phases

Baseline efficiency measurement

Baseline efficiency measurement was done based on an existing data collection system. During interviews with company management, lead time and delivery reliability were identified as order winners. This is why it was decided that lean implementation efforts should be aimed at shortening lead times and improving delivery reliability. Lead time was measured as the difference between the time when order left the company and the time when order entered the company. Delivery reliability was measured through percentage of late orders (number of orders delivered late divided by total number of orders), and average lateness (the difference between actual and promised delivery dates). Data was collected continuously, for each order. Collected data was later analyzed together with managers and employees of the company.

Lean implementation

A tool-agnostic approach to lean implementation was taken, meaning that focus was on underlying lean principles rather than on lean tools. Specific problems were analyzed in the light of lean principles, while tools were developed and used in accordance to identified problems. Lean implementation was guided by lean definition given by Hopp & Spearman (2004), where production of goods is considered lean if it is accomplished with minimal buffering costs. There are two sources of excess buffering. First source is obvious or big waste that has no rational reason for existence (Liker & Meier, 2006). This includes operations that are not needed, unreliable machines, rework, unnecessary waiting, excessive setup times, etc. This type of waste can be reduced without creating another form of waste is obvious waste. Second source of excessive buffering is variability that can take on many forms, including variability in process times, delivery times, yield rates, staffing levels, demand rates, etc. Variability can be external (irregular demand, product variety, changes in orders, etc.) or internal (excessive processing steps, unnecessary movements, setups, etc.). If variability exists it will be buffered with one of the following types of buffers: inventory, capacity or time. This is the type of waste that cannot be reduced without creating another waste (according to Little's law, changing one buffer without addressing the source of variability affects the size of other buffers, see e.g. Little, 1961).

Based on the lean definition presented in the text above, conceptual lean implementation model was designed and followed (Figure 2).

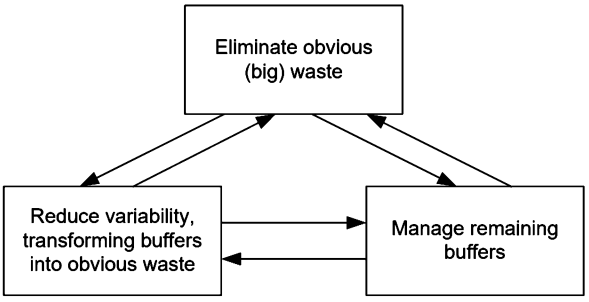


Figure 2: Lean implementation conceptual model

Eliminating obvious waste means removing everything that does not add value to the customer, and has no rational reason for existing. Reducing variability (both internal and external) decreases the requirements for buffers, thus transforming buffers to obvious waste (i.e. less variability removes reasons for buffers to exist). Variability that remains must be buffered or isolated in order to reduce the impact of variability on the entire value chain. The remaining buffers must be right-sized and balanced (i.e. by exchanging expensive buffer such as inventory for a less expensive one such as capacity) in order to improve flow and reduce the cost of buffering.

Over-processing and waiting were recognized as most significant obvious waste. Over-processing starts at engineering, where engineers thought that products that are more complicated then customer required had more value. In addition, engineers were pressured by short due dates, which prevented product refinement. This means that product manufacturability was rarely analyzed, which led to over-processing in manufacturing. Other obvious waste is waiting, where about two thirds of the entire lead time the order spends waiting. Uncontrolled order release was identified as main cause of waiting, since it leads to high levels of WIP and shop-floor congestion. This problem was resolved through controlled order release, based on input output control. Input control (releasing new orders based on the shop load) was deemed to be less feasible, because delaying order release was usually not possible, since due dates are usually tight. Shop-floor congestion was mainly resolved through output control, i.e. short-term capacity adjustments (overtime

or additional shifts) with the aim of increasing throughput. In addition to eliminating over-processing and waiting, operations were analyzed in order to identify and eliminate unnecessary activities and motion.

Variability was reduced mainly through standardization. Operations were analyzed and improved, and new standard operating procedures (SOP) were introduced. SOPs consist of three parts: (i) first part contains information about workplace preparation; (ii) second part contains information about performing operations on a workplace; and (iii) third part contains information regarding preventive maintenance of production resources and workplace. Greatest challenge was to create SOPs for assembly, since sequence and content of assembly operations might differ significantly from one order to another. This was resolved through division of assembly operations to smaller elements (different ways of putting elements together) which were standardized and written down to a SOP. SOP for an entire product is obtained by combining different SOPs for elements of operations. Special attention was given to setup reduction, where SMED (Single-digit Minute Exchange of Die) method was applied. Setup activities were analyzed and standardized, and new setup procedures were devised. Prototype production was a major source of variation. Engineers used to make requests for prototype production in an unstructured and erratic manner, thus interrupting production and introducing additional variability. This was resolved by introducing time slots (one hour at the beginning of each shift) which were used entirely for prototype production, while producing prototypes outside of this time slots was possible only by order of production manager.

Remaining variations were isolated through buffer introduction. First buffer was introduced at order acceptance phase in order to separate operations from demand variations. Orders were placed in an order pool, from which they were picked and released according to available capacities of engineering department. Engineering process is unstructured and unpredictable, and presents significant source of variation. In order to prevent transfer of variations to manufacturing, another buffer (pool) was introduced after engineering, and before manufacturing, so impact of variation could be isolated in engineering department. High WIP levels were used to buffer internal variability. They were used as a source of autonomy, where it was up to operators to select next order to be processed. The result was los of 'natural' flow of orders, shop-floor congestion, difficulties in tracking orders, orders getting lost, etc. this was resolved through 'swapping' one buffer for another, i.e. inventory (WIP) buffer for capacity buffer. As it was said earlier, controlled order release could not be obtained through input control, so it was obtained through output control, i.e. increase of throughput. Capacity slack was created through short-term capacity adjustments that were used when shop-floor was threatened to be congested. Work center load was used as a capacity adjustment trigger. Maximum allowed work center load was determined, and capacity was adjusted when it was estimated that maximum allowed load was to be violated. Lowering levels of WIP allowed for material to be moved through shop-floor in accordance to FIFO principle, thus lowering demand for order dispatching.

All actions aimed at waste elimination, variability reduction, and buffer management should be taken in accordance to scientific approach, i.e. through usage of PDCA cycle.

Post implementation efficiency measurement

Post implementation measures were taken during and after lean implementation. In order to facilitate gathering of data, new order tracking system was designed. New system facilitated information gathering and analysis, since data was collected in a way that enabled their use without significant amount of data processing (i.e. it was possible to analyze data in their 'raw' form). As was the case in baseline period, data was collected continuously, for each order. Data was gathered and analyzed together with managers and employees.

4. RESULTS

Data on lead times and delivery reliability were taken during 2015. The entire period was divided in two shorter periods, in order to track changes in lead times and delivery reliability before and after lean implementation: (i) period 1 – weeks 1 to 35, before lean implementation; and (ii) period 2 – weeks 36 to 52, after lean implementation. Figure 3 shows average lead time before and after lean implementation. Although measurements were taken per work order, the results are grouped per week, for the sake of better visibility.

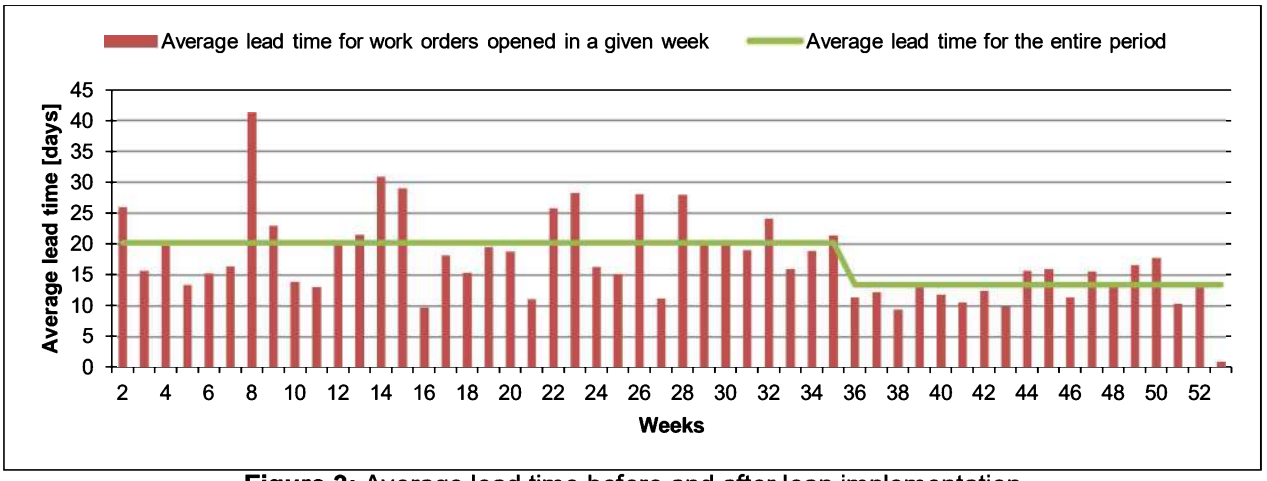


Figure 3: Average lead time before and after lean implementation

The results show that average lead time after lean implementation is shorter than the one before implementation. Before implementation, average lead time was 20.17 days, while after lean implementation it was reduced to 13.43 days. Standard deviation of lead times was also reduced, from 19.8 to 10. Decrease in lead times was obtained through two main courses of actions. First course of action was reducing and controlling variability, both in effective processing times and inter-arrival times. Reduction in processing times and inter-arrival times resulted in reduced wait time, which was estimated to 13 days before lean implementation (net time was estimated to be around 7 days). Processing time variability was reduced through waste elimination, standardized operating procedures, setup time reduction and standardization, and improved maintenance. Inter-arrival time variability was reduced through separation of demand and production, with introduction of two order pools in front of and right after engineering department, aimed at stabilizing the inflow of new orders, both in the company as a whole, and in manufacturing. These results support the claims presented by Kingman (1961) that waiting time in queue is directly influenced by variability. Second course of action was in accordance to Little's (1961) law, where lead time is affected by throughput rate and WIP. With tight due dates and constant pressure, it was hard to limit the amount of WIP on the shop floor, co congestion was managed through output control, i.e. short term capacity adjustments such as overtime and additional shifts.

Figure 4 shows the distribution of lead times before lean implementation and after lean implementation.

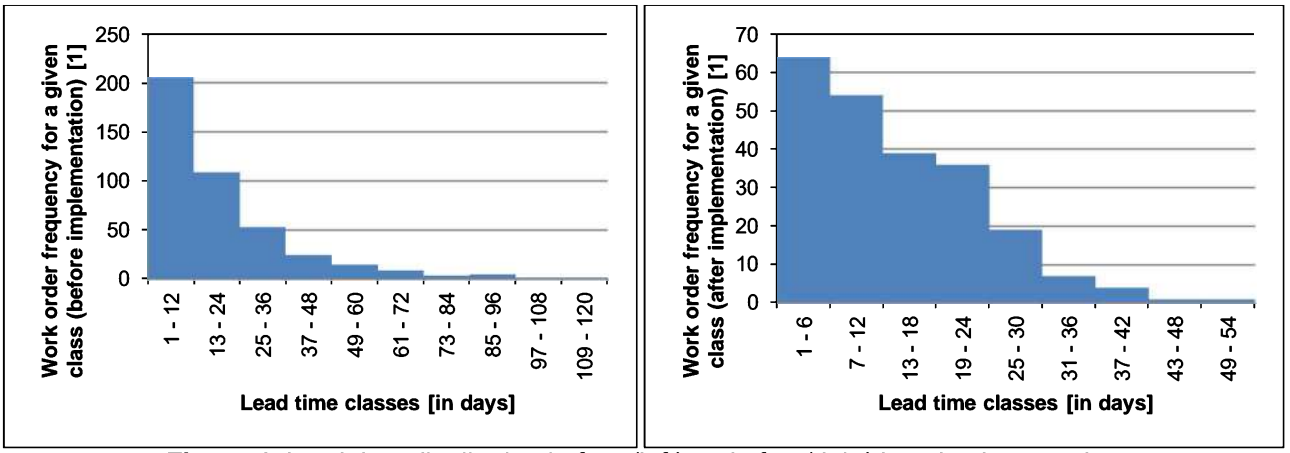


Figure 4: Lead time distribution before (left) and after (right) lean implementation

The results show that lead time range is significantly smaller after lean implementation, which effected the average lead time itself. In addition, more control of work orders was established through lean implementation, which is supported by the fact that lean implementation eliminated work orders with extremely long lead times. This led to less congestion on the shop floor, which reduced the opportunities to change order priorities, as well as the need for order dispatching. As a result, it became possible to use simple dispatching rules, such as FIFO, and to maintain the 'natural' flow of orders.

Figure 5 shows number of work orders completed before due date, on time, and after due date. As before, weeks 1 to 35 are before lean implementation, while weeks 36 to 52 are after lean implementation.

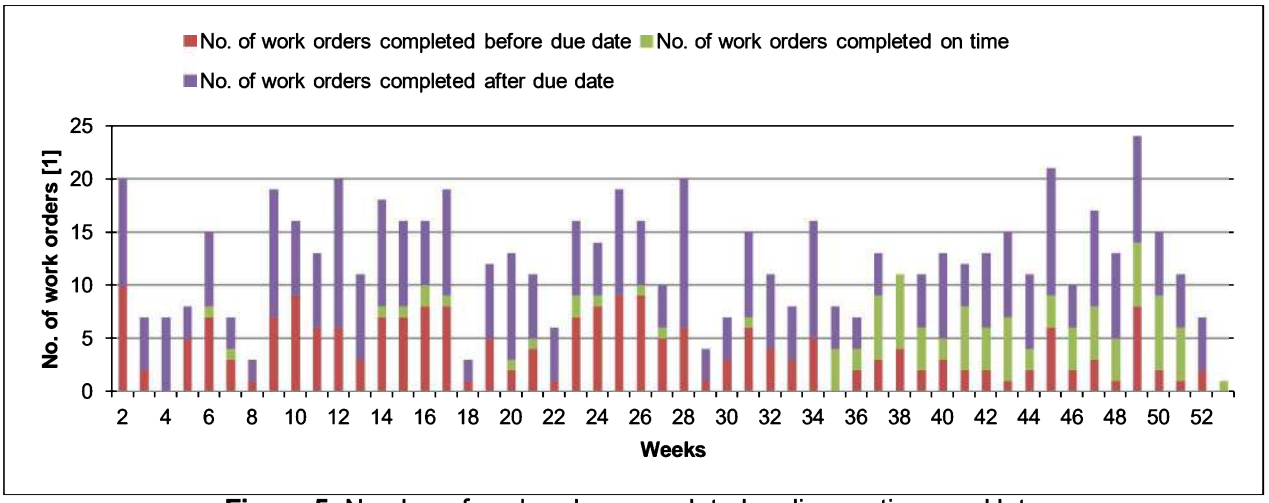


Figure 5: Number of work orders completed earlier, on time, and late

The results show that number of work orders completed late was lower after lean implementation. The percentage of late orders decreased from 55.5% to 46.7%. In addition, the number of work orders completed on time increased significantly, as shown on Figure 5. As a result, less work orders were completed late, as well as early, which increased service level of the company.

The distribution of lateness was also analyzed, as shown in Figure 6. The results show that, while lateness range stayed rather unchanged, distribution function became much narrower after lean implementation (right hand side if the figure). The results show that work orders are accumulated in a class that represents work order completion on time, or with a minimal earliness or lateness.

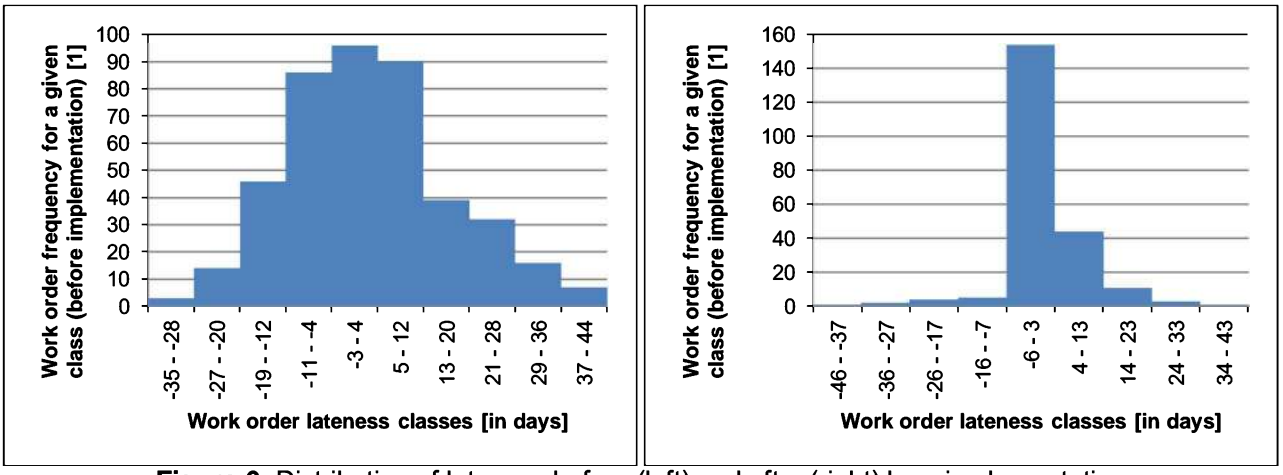


Figure 6: Distribution of lateness before (left) and after (right) lean implementation

Results presented in Figures 5 and 6 suggest that average lateness should have decreased after lean implantation. In order to test this hypothesis, average lateness before and after lean implementation was measured in details. The results are presented in Table 1.

Table 1: Average lateness before and after lean implementation

	Period	Sample size	Average	Standard deviation
Average lateness	Before	238	12.7269	9.83948
	After	105	7.1619	7.11056

The results show that average lateness decreased from 12.7 days to 7.2 days. In addition, standard deviation of lateness decreased from 9.8 to 7.1. Lead time reduction had a great impact on delivery reliability improvement, supporting the claim that improved delivery reliability can be a consequence of shorter lead times and/or lower standard deviation of lead times.

5. CONCLUSION

Evidence of lean being used from efficiency improvement in repetitive manufacturing are abundant. However, evidence of lean being used to improve efficiency of ETO operations are few and far between, thus raising the question of lean universality. This paper presents the results of an action research in efficiency improvement in an environment that is often considered as inappropriate for lean implementation. The results obtained through the research add to the fact that lean can be used for improving efficiency of ETO operations. ETO companies operate in turbulent environment, which is a fact they often use as an excuse for efficiencies. Variability is inherent to ETO operations, since ETO companies 'sell' variability, both in production mix and volume. So, rather than passively reacting to variability, ETO companies should take a more proactive stance, and put efforts to actively control variability. The fact that ETO companies 'sell' variability calls for caution. Some variability should be reduced, while some should be isolated and controlled. If there is no rational reason for variability to exist, then it is waste and it should be eliminated. If variability has to exist, it has to be managed as much as possible, and buffered in an effective way.

Production system introduced to company ALPHA was not a copy of TPS. This means that lean implementation was not formulaic, stripped down to mere tool implementation. Rather, it was TPS based production system, built on underlying lean principles that were used by Toyota to develop tools for specific problems. This approach reduces chance for failure, since it is advocates contextual approach that avoids prejudging solutions, but takes into account characteristics of a specific manufacturing environment and builds efficiency improvement on laws that define lean.

REFERENCES

Amaro, G., Hendry, L., & Kingsman, B. (1999). Competitive advantage, customisation and a new taxonomy for non make-to-stock companies. *International Journal of Operations & Production Management*, *19*(4), 349-371.

Bhamu, J., & Sangwan, K. S. (2014). Lean manufacturing: literature review and research issues. *International Journal of Operations & Production Management*, *34*(7), 876-940.

Birkie, S. E., & Trucco, P. (2016). Understanding dynamism and complexity factors in engineer-to-order and their influence on lean implementation strategy. *Production Planning & Control*, 1-15.

Cooney, R. (2002). Is "lean" a universal production system? Batch production in the automotive industry. *International Journal of Operations & Production Management*, *22*(10), 1130-1147.

Coughlan, P., & Coghlan, D. (2002). Action research for operations management. *International journal of operations & production management*, *22*(2), 220-240.

Cusumano, M. A. (1994). The Limits of" Lean". *Sloan Management Review*, *35*, 27-27.

Gosling, J., & Naim, M. M. (2009). Engineer-to-order supply chain management: A literature review and research agenda. *International Journal of Production Economics*, *122*(2), 741-754.

Hendry, L. C., & Kingsman, B. G. (1989). Production planning systems and their applicability to make-to-order companies. *European Journal of Operational Research*, *40*(1), 1-15.

Hines, P., Holweg, M., & Rich, N. (2004). Learning to evolve: a review of contemporary lean thinking. *International Journal of Operations & Production Management*, *24*(10), 994-1011.

Holweg, M. (2007). The genealogy of lean production. *Journal of operations management*, *25*(2), 420-437.

Hopp, W. J., & Spearman, M. L. (2004). To pull or not to pull: what is the question?. *Manufacturing & Service Operations Management*, *6*(2), 133-148.

Hopp, W. J., & Spearman, M. L. (2008). *Factory physics*. Waveland Press.

Hüttmeir, A., de Treville, S., van Ackere, A., Monnier, L., & Prenninger, J. (2009). Trading off between heijunka and just-in-sequence. *International Journal of Production Economics*, *118*(2), 501-507.

Jina, J., Bhattacharya, A. K., & Walton, A. D. (1997). Applying lean principles for high product variety and low volumes: some issues and propositions. *Logistics Information Management*, *10*(1), 5-13.

Kingman, J. F. C. (1961). The single server queue in heavy traffic. In *Mathematical Proceedings of the Cambridge Philosophical Society* (Vol. 57, No. 04, pp. 902-904). Cambridge University Press.

Lander, E., & Liker, J. K. (2007). The Toyota Production System and art: making highly customized and creative products the Toyota way. *International Journal of Production Research*, *45*(16), 3681-3698.

Liker, J. K., & Meier, D. (2006). *The Toyota way Fieldbook, a practical guide for implementation Toyota's 4P's*. McGraw-Hill.

Little, J. D. (1961). A proof for the queuing formula: L= λ W. *Operations research*, *9*(3), 383-387.

Monden, Y. (1983). *Toyota production system: practical approach to production management*. Norcross, GA: Industrial Engineering and Management Press, Institute of Industrial Engineers.

Naim, M. M., & Gosling, J. (2011). On leanness, agility and leagile supply chains. *International Journal of Production Economics*, *131*(1), 342-354.

Ohno, T. (1988). *Toyota production system: beyond large-scale production*. Productivity press.

Papadopoulou, T. C., & Özbayrak, M. (2005). Leanness: experiences from the journey to date. *Journal of Manufacturing Technology Management*, *16*(7), 784-807.
Portioli–Staudacher, A., & Tantardini, M. (2012). Lean implementation in non–repetitive companies: a survey and analysis. *International Journal of Services and Operations Management*, *11*(4), 385-406.
Schein, E. H. (1999). *Process consultation revisited: Building the helping relationship*. Reading, MA: Addison-Wesley.
Shingo, S. (1989). *A study of the Toyota production system: From an Industrial Engineering Viewpoint*. Productivity Press.
Slović, D., Stojanović, D., & Tomašević, I. (2015). Productivity Upswing Through Two-Phase Continuous Process Improvement Model: The Case Of Apparel Manufacturer. *Journal of Textile & Apparel/Tekstil ve Konfeksiyon*, *25*(2). 89-96.
Stump, B., & Badurdeen, F. (2012). Integrating lean and other strategies for mass customization manufacturing: a case study. *Journal of Intelligent manufacturing*, *23*(1), 109-124.
Westbrook, R. (1995). Action research: a new paradigm for research in production and operations management. *International Journal of Operations & Production Management*, *15*(12), 6-20.
White, R. E., & Prybutok, V. (2001). The relationship between JIT practices and type of production system. *Omega*, *29*(2), 113-124.
Womack, J. P., & Jones, D. T. (1996). *Lean thinking: banish waste and create wealth in your corporation*. Simon and Schuster.
Womack, J. P., Jones, D. T., & Roos, D. (1990). *The machine thatchanged the world*. New York: Rawson Associates.
Yin, R. K. (2013). *Case study research: Design and methods*. Sage publications.

TOWARDS SUSTAINABILITY: MASS CUSTOMIZED-LEAN-AGILE-FIT OPERATIONS MANAGEMENT IN BANKING

Vesna Tornjanski*[1], Sanja Marinković[1], Željka Jančić[2]
[1]Faculty of Organizational Sciences
[2]Eurobank a.d. Belgrade
*Corresponding author, e-mail: vtornjanski@gmail.com

Abstract: *This paper aims to deepen and broaden the scientific fund of recently advocated paradigms that will significantly reshape operations management in banking industry in years to come. The purpose of this paper is to guide operations managers in banking towards economic sustainability by providing a conceptual architecture of digital platform for operations services to reduce complexity, time to market, and at the same time to visualize operations activities, i.e. to effectively support mass customized-lean-agile-fit operations strategies. Further, taking into account that the major challenge in mass customization paradigm is to determine product offerings, the paper provides a two-phase approach consisting of Total Unduplicated Reach and Frequency (TURF) analysis to facilitate a choice of new services imposed by market requirements and Analytic Network Process based on BOCR model (ANP-BOCR) to segregate a core from actual and augmented mass customized services. The study may be useful for operations managers in financial services, innovation, IT and business decision management.*

Keywords: *operations management, mass customization-lean-agile-fit operations strategy, banking industry, economic sustainability, conceptual architecture of digital platform, TURF analysis, ANP-BOCR method*

1. INTRODUCTION

The concept of sustainable development has been extensively studied from various aspects in the theoretical literature over the time. The analysis of hundreds definitions of sustainable development concept depicts that there is no unique and comprehensive formulation which provides clear understanding of the phenomenon due to its complex and multidimensional issue, which indicates that sustainable development should be considered as an integrated system of economic, ecological, social and institutional perspectives (Jiliberto, 2003; Ciegis et al., 2009).

In the face of an intense competition, comprehensive changes in technology, customers' demands, regulatory requirements and demographic changes into the volatile business environment, strategic managers worldwide understand sustainable business development not only as an option, but as a fully integrated paradigm into the strategy and operations of organizations. According to the Lacy et al. (2010), ninety-three percent (93%) of the 766 CEOs have stated that sustainability is significant issue to the organization's future success. Yet, businesses worldwide are rapidly digitizing, breaking down industry boundaries, building new opportunities, and at the same time harming long-successful business models (Weill & Woerner, 2015; Tornjanski et al., 2015). The phenomenon of digital disruption remarkably changes banking industry, indicating the considerable redesign of operating model in years to come. These underlying influences put sustainability in narrow focus of executives and at the same time create big pressure on banks to continuously evolve, by changing its strategic context and competitive dynamics (Propa et al., 2015; Weill & Woerner, 2015). In such circumstances, operations management as a central core function and its dynamic capabilities are of strategic importance to an organization (Brown et al., 2013), taking into account its significant role in overall organizational performances (Slack et al., 2004; Zangiski & da Costa, 2013). In the age of the third industrial revolution, adjusting complexity, harmonizing confronted requirements and dynamic processes with all accelerated changes under uncertainty, while effectively managing both internal and external interdependencies with various stakeholders that have different requirements and needs, have always represent challenge for operations management in banking. However, in the volatile times, it became challenge of key importance for organizational sustainability and business development (Slack, 2015; Sprogies & Schmidt, 2015).

Given that banking sector is undergoing significant transformation towards structure that follows principles of flexibility, openness and customer-centricity, sustainability from operations management aspect may be achieved if operations managers in banking industry understand what they have to provide and how to leverage resources and capabilities as an integrated system (Fasnacht, 2009; Huo & Hong, 2013; Tornjanski et al., 2015a).To this end, operations managers in banking industry have to develop the ability to tailor the appropriate strategies with clear long-term vision and strong short-term implementation capacities to effectively boost transformation of operating model from traditional "back-office" role toward "strategic" role with the possibility not only to support business strategies, but also to shape new ones for well-being of an organization on the long run (Henderson & Venkatraman, 1999).

With that in mind, this paper aims to extend and deepen the scientific fund of recently advocated paradigms that will significantly reshape operations management in banking industry in years to come. The purpose of this paper is to guide managers in banking to effectively support mass customized-lean-agile-fit operations strategies. Further, taking into account that the major challenge in mass customization paradigm is to determine product offerings, we aim to provide a framework to facilitate strategic decision making.

2. LITERATURE REVIEW

The field of operations management in service organizations has evolved tremendously over the years due to changes in market requirements (Gunasekaran & Ngai, 2012). The dynamic customer expectations, increased competition, advancements in information and communication technologies, development of knowledge-based economy (Kriščiūnas & Daugėlienė, 2015), financial market globalization and economic recession have forced service operations managers to approach the transition (Vinodh et al., 2014). The fundamental requirement in transition is change of operating models which implies an introduction and application of appropriate strategies and paradigms towards continuous operations improvements. As a result, service operations management has entered into the “mass customization-lean-agile-fit” era (Zhao & Lee, 2009; Gunasekaran & Ngai, 2012; Brownet al., 2013; Tseng & Hu, 2014; Vinodh et al., 2014), which significantly reshapes operations management in service sector today.

2.1. Mass customization

Mass customization has emerged as an important paradigm due to the heterogeneity of individual needs, competitive intensity and shortens product life cycles (Huang et al., 2008; Khalili-Araghi & Kolarevic, 2016).There is a wide variety of understandings of this phenomenon viewed from different perspectives. From a customer perspective, the paradigm enables superior customer value by providing products / services that meet individual needs (Tseng& Jiao, 2001). From the service operations management perspective, mass customization refers to the ability to quickly provide customized products in high volumes, with quality that will satisfy end user, minimal costs and time to market (MacCarthy et al., 2003). In other words, mass customization is a “paradigm that seeks, as its goal, to combine the value-added effectiveness associated with product customization with the cost-efficiency closely related to mass production” (Huang et al., 2008, p. 716). According to the Papathanassiou (2004), development of customized services is recognized as one of the top priorities in the service industry nowadays. However, customer driven business is both, an imperative and a potential threat. Gilmore & Pine (1997) pointed out that many companies have introduced new procedures and programs to meet every customer's requirement. Yet, such approach has caused additional costs and complexity to operations. In response to this issue, four unambiguous approaches to customization have been advocated, i.e. collaborative, adaptive, cosmetic and transparent customization. Pine et al. (1995) suggest that modular system, information availability to employees, incorporation of customers into an evaluation process for product / service development and creation of direct link with customers are elements that should be taken into account when companies embark development of mass customization strategies and architectures.

This concept shifts design, distribution and processes from "made-to-stock" to "made-to-order", which significantly challenges the conventional product development, process and supply chain management (Tseng & Hu, 2014).To effectively support mass customization strategy, organizations should reconsider the entire value chain from front to end, by efficiently adjusting economy of scale, variety and time to market (Tseng & Hu, 2014) and effectively managing the dynamics and trade-offs among product design, system design and supply chain design (Hoekstra & Nahmens, 2005).

2.2. Lean, agile and fit framework for service operations management

Lean philosophy advocates elimination of any kind of waste, including a reduction of non-value-added activities to continually improve company’s wealth creation capability (Droste, 2007; Lester, 2008; Womack & Jones, 2010). Although manufacturing organizations were the beginners of lean adoption (Hines et al., 2004), service organizations are increasingly inspired by lean management. Among all, financial services are

pressed to improve operational efficiency due to strict governmental regulations and intense competition determined by non-financial companies and changes in customers' behavior (Staikouras & Koutsomanoli-Fillipaki, 2006; Leyer & Moormann, 2014). Despite increased interest in the application of this paradigm, financial services often experience difficulties in successful adoption of lean. One of the reasons lies in an insufficiently explored phenomenon in financial services in both, the theory and practice. Leyer & Moormann (2014) have stated that only few case studies dealt with the applicability of lean in financial services. Prior theorists note that implementation of manufacturing lean principles in financial service organizations cannot be treated equally due to their contextual differences (De Treville & Antonakis, 2006), i.e. differences in nature of goods and services, operation processes and the way of customer integration in manufacturing and financial service organizations (Leyer & Moormann, 2014).

Early works on lean principles specify two fundamental criteria that characterize lean: just in time (JIT) and automation. Just in time represents a "pull" system in which production process starts only when it is signaled by the customer downstream, while the objective of automation is not to throw out production employees, but rather to shift them on those aspects of business which create the highest value (Womack & Jones, 1996; Ohno, 1988; Staats et al., 2011). Value, value stream, flow, pull, and excellence are five categories that refer to definite lean management concept (Womack & Jones, 1996). Value refers to a product / service that is offered to customers, along with the works backward to build an operation process. Value stream ensures that each step creates value in value chain. Flow reorganizes processes in order to have smooth delivery operation through the value-creation exercise, while pull represents a mechanism for limiting waste in operation processes (Hopp & Spearman, 2004). Finally, excellence requires continual striving to meet customer requirements, and at the same time to improve processes with zero defects (Staats et al., 2011). Mefford (1993) stated that just in time, high performance work systems and total quality management are management practices that characterize lean paradigm. However, Shah & Ward (2007) argue that these practices are not sufficient to adequately explain an entire idea of lean management (Leyer & Moormann, 2014). According to De Koning & De Mast (2006), lean represents an integrated system of principles, tools, techniques and practices aimed at waste reduction, synchronization and management of workflows in organization. In addition, Rother (2009) recognizes that employees' capability to think and act towards lean, i.e. to be focused on efficiency and value-creating processes in day-to-day business activities is equally important element in lean management. In accordance to that, a change in an organization's management system is perceived as an important element for sustainable implementation of lean management, too (Mann, 2014; Leyer & Moormann, 2014). A common denominator in all lean aspects is fundamental idea of optimization and continual improvement of operations processes (De Koning et al., 2008). The adoption of lean philosophy in organization is assumed to be in positive correlation with increased efficiency (Dahlgaard & Dahlgaard-Park, 2006), and in negative correlation with cycle time and costs, which results in more agile, customer-responsive and competitive organization (Alukaj, 2003).

Agile service operations management requires quick respond to changes in demand in terms of both volume and diversity (Christopher, 2000; Power et al., 2001). Naylor et al. (1999) defines agility as a usage of market knowledge and a virtual organization to bring about profitable solutions and alternatives in a volatile marketplace. According to the Power et al. (2001, p. 247) "The notion of agility is therefore recognized to be holistic rather than functional, and of strategic rather than tactical importance. The concept has also been extended beyond the traditional boundaries of the individual organization to encompass the operations of the supply chain within which the organization operates". It has been argued that organizations could thrive in rapid and unpredictable business environment by acting in an agile manner (Nagel & Dove, 1991; Bruce et al., 2004).

A holistic approach that integrates mass customization, lean and agility, i.e. fit framework is a new model for economically sustainable organization (Pham & Thomas 2011; Vinodh et al., 2014). Prior theories strengthen fit framework which combines these concepts and allow organizations to tune its operational and technological capabilities (Pham & Thomas 2005). Fit framework provides a new operations management perspective and new operations management strategy to accomplish dynamic strategic objectives. Innovative concept with holistic perspective, built upon the principles of these paradigms, is recognized as an effective strategy towards organizations' economic sustainability (Pham & Thomas 2005; Pham & Thomas 2011; Vinodh et al., 2014) and should be integral part of strategic and sustainable strategies in banking industry, too.

3. METHODOLOGY

For the purpose of this paper, the method of case study has been recognized as the most suitable research method to deeply understand the role and issues of operations management in banking, thus to ensure a holistic view on the researched phenomena in real life. Within the case study, we have incorporated a multi-method approach to strengthen the results on a given research problem.

To understand a specific problem, in-depth interviews were conducted with the senior managers in operations area of the bank under the study as a targeted sample of respondents for the sake of ensuring that the participants meet the requirements to be included in the study.

Thereafter, to answer "how" to effectively support mass customized-lean-agile-fit operations strategies in banking, we have developed a conceptual architecture of digital platform for operations services to reduce complexity, time to market, and at the same time to visualize operations activities. Further, taking into account that the major challenge in mass customization paradigm is to determine product offerings, i.e. in order to understand "what" operations management needs to provide to internal and external stakeholders to meet both strategic goals and end users' requirements, we propose a two-phase approach for selection process.

Phase I

First phase encompasses the selection of new services. The beginning of process is based on the principles of mass customization paradigm, which implies the inclusion of end users in the evaluation process. A survey method is carried out among experts of the bank under the study by conducting a web-based questionnaire as a survey instrument. Experts of the bank were asked to select the combination of proposed services with the aim to ensure that the possible introduction of new services would reach its maximum usage according to the business needs.
In other words, $y_i=\{1, end\ user\ i\ will\ use\ service; 0, end\ user\ i\ will\ not\ use\ service\}$. The results are derived using a Total Unduplicated Reach and Frequency (TURF) analysis that is substantiated by the equations (1) and (2) (Serra, 2013):

Equation 1 is used to reach maximum penetration of final combination of services, i.e. number of end users that are subjected to a limited number of varieties.

$$\max\ Z = \sum_{i=1}^{m} y_i \tag{1}$$

Equation 2 is used to reach maximum frequency of varieties, i.e. the highest number of selected services by each user.

$$\max\ Z = \sum_{i=1}^{m} f_i y_i \tag{2}$$

The results of TURF are analyzed in Excel spreadsheet with the advanced option for solving mathematical programming problems.

Phase II

Second phase implies final selection and segregation of core from actual and augmented mass customized operations services. In this phase, the Analytic Network Process (ANP) multi-criteria method is applied in modelling and quantitative analysis of service lines and their relative weights in regard to benefits, opportunities, costs and risks (BOCR) (Saaty & Vargas, 2001; Saaty & Ozdemir, 2005; Saaty, 2009; Tornjanski et al., 2014) to estimate all the effects when making decision. Final BOCR decision model is shown in Figure 1. Pair-comparisons is carried out by decision maker of the bank under the study using a nine-point Saaty's scale.

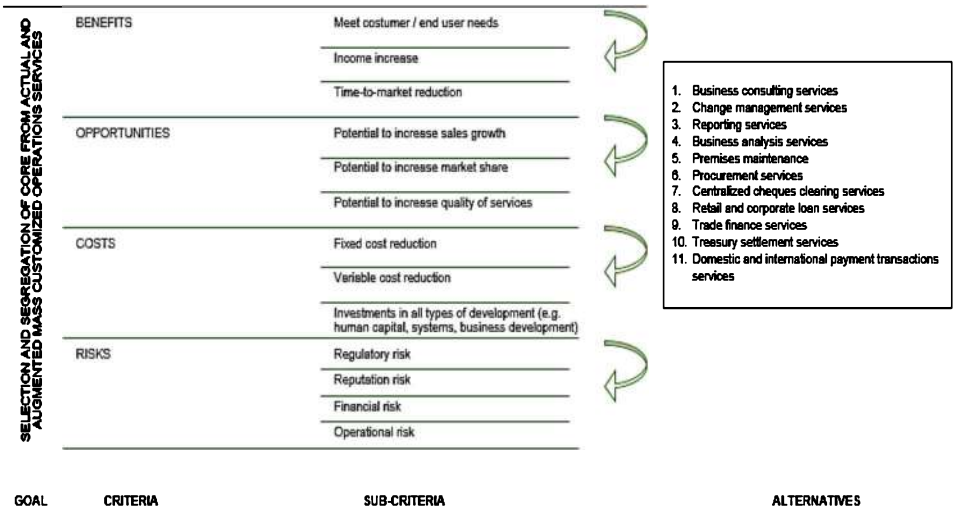


Figure 1: BOCR decision model (Source: Authors)

According to the pair-comparison matrix, local priority vector is obtained by solving (3) (Liang & Li, 2008):

$$A\omega = \lambda \max W \tag{3}$$

Where
A is the pair-comparison matrix
Λmax is its largest eigenvalue
W is the local priority vector.

Next, unweighted supermatrix, weighted supermatrix, cluster matrix and limit supermatrix are constructed. In order to obtain final results, the whole model is synthesized. To calculate the final rank of alternatives, Saaty proposes two ways of calculation. In this paper, the subtractive method is applied using the formula (4) (Saaty & Ozdemir, 2005; Saaty, 2008; Liang & Li, 2008; Tornjanski et al., 2014):

$$bB + oO - cC - Rr \tag{4}$$

Where
b, o, c, r are the priorities for BOCR merits in regard to strategic criteria (Liang & Li, 2008). The results are derived using Super Decisions software package for decision making.

4. RESULTS AND DISCUSSION

The bank under this study (hereafter: the bank) is a European bank which began operations in Serbia in 2003. Today it services more than 900.000 clients with 1.500 employees. With total market share of 4.61% it is ranked among the top 10 banks according to balance sheet assets in the banking sector of Serbia (NBS, 2015).

4.1. Understanding the problem

In an in-depth interview conducted in the bank, decision maker stated: "*Operations function in our bank represents an engine of the organization which simultaneously provides services, information and knowledge to numerous internal and external stakeholders that have different and often confronted requirements* (Figure 2). *Nevertheless, during the years of successful business in Serbia, Operations function has significantly contributed to the results of the bank, mainly due to established strategic alignment with business strategies and proper management of operations. These and many other efforts invested by the management and experts' team from the Operations function have resulted in an overall improvements of the bank's performances…*"

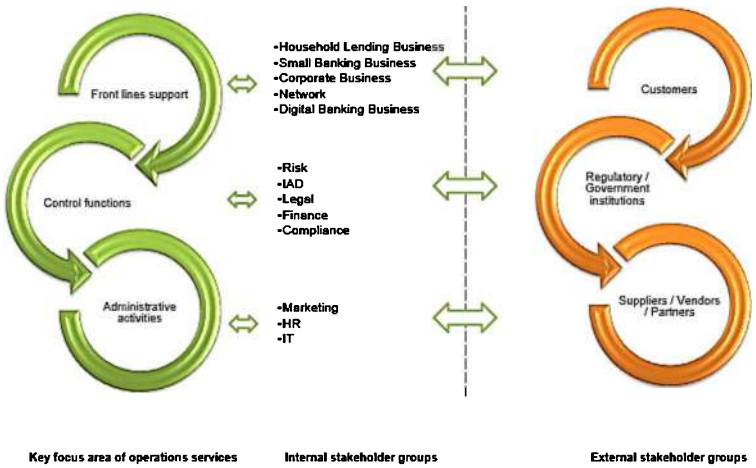


Figure 2: General overview of key focus area of operations services and stakeholders (Source: Authors)

However, decision maker emphasized that: "*Operations function should continue to evolve to ensure economic sustainability for the bank. To this end, we have recognized that it is of paramount significance to develop a model which will visualize operations activities, reduce complexity and time to market with the possibility to effectively support mass customized services and lean operations strategies into everyday business*".

Further, one of the senior managers of the bank has explained the role of operations management and pointed out issues that disrupt operations management today: "*Operations management faces multidimensional complexity when looking for ways in supporting all functions of the bank in achieving sustainability. Regardless of the organizational model followed by the bank, operations activities are placed at the core of the bank right in the crossroads of support to frontlines facing customers, managing administrative functions facing third party vendors and facilitating control functions facing regulatory bodies. Such position puts great challenge on operations managers to determine the right product and resources mix given that it needs to respond both to continuous changes in demand on all internal functions it supports and all external parties those functions are exposed to, in parallel ensuring that costs and resources are kept at optimum level and easily adjustable to changes. This clearly gives additional significance to question of achieving sustainability when operations managers are concerned. To this direction the first aspect which needs to be put in place is segregation between core and additional services which one operations manager needs to support. It is clearly dependent as priority by regulatory requirements as for such activities there is no alternative, but going further from those the variety of indicators coming from market needs (e.g. digitalization), top management strategic focuses (e.g. corporate vs. retail banking), external opportunities for collaboration (e.g. outsourcing) needs to be continuously evaluated in order to provide balanced operational support. Common denominator which always needs to be considered is available resources and how to keep them as flexible as the demand. This is where appropriate models will play the key role for operations managers. All operations managers inevitably will have available or even participate to design of variety of information influencing their activities such as market information, sales targets, product development plans, procurement plans, regulatory requirements, budget forecasts. Key challenge is how to filter all those data in order to identify key indicators which ought to shape operations manager strategy and how to monitor and have early alert on changes of those indicators in a way to efficiently adjust and prioritize operations services and resources".*

4.2. Towards mass customized-lean-agile-fit operations management

Conceptual architecture of digital platform for operations services aims to reduce complexity, time to market, and at the same time to visualize operations activities, i.e. to effectively support mass customized-lean-agile-fit operations strategies. Conceptual architecture of digital platform for operations services is shown in Figure 3 and aims to link value chain from front to end in order to provide mass customized services, information and knowledge, to enable continuous optimization, improvement of operations processes by eliminating waste and by allowing quick respond to changes in demand in terms of both, volume and diversity.

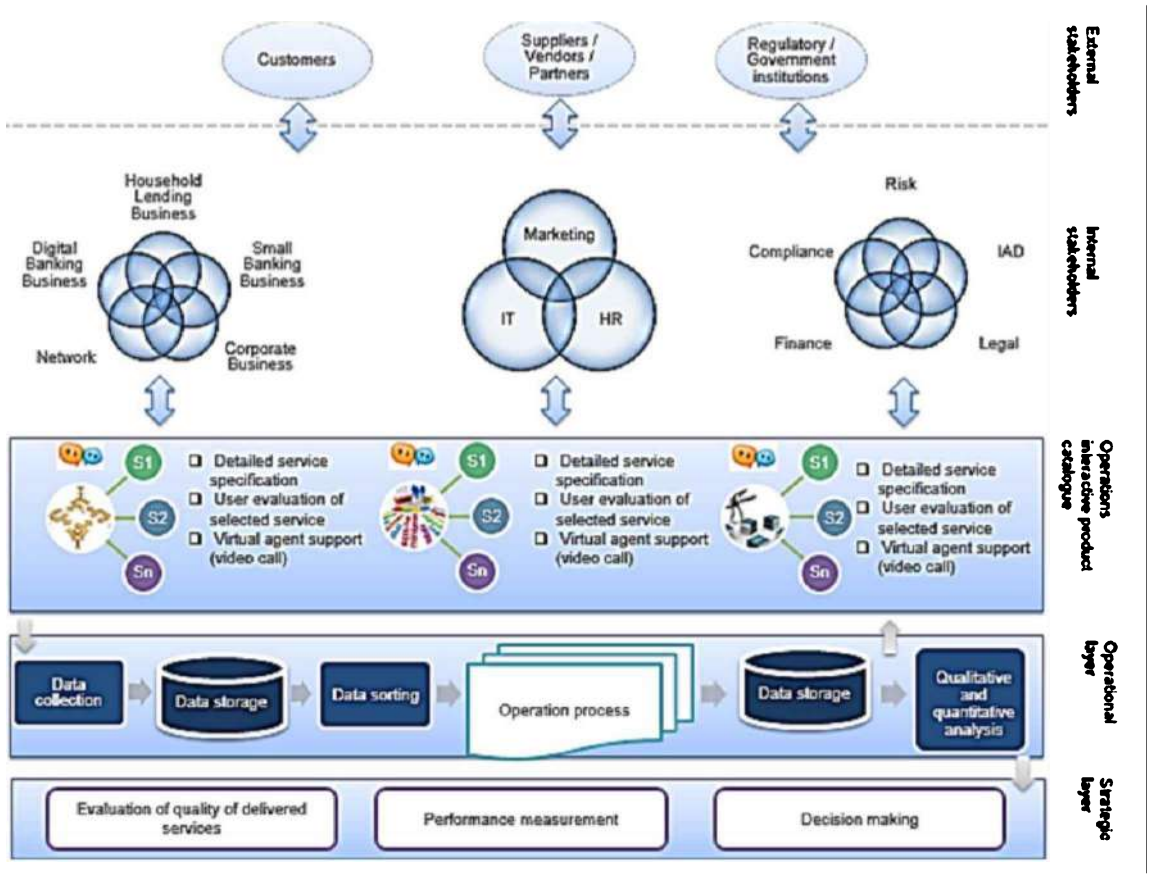


Figure 3: Conceptual architecture of digital platform for operations services (Source: Authors)

The platform consists of three layers. First layer of the architecture represents operations interactive product catalogue which allows users self-service by selecting multiple available services, in any combination, provided by operations function. Each service has a detailed specification to enable stakeholders sheer understanding of the offer in real time, and at the same time enables interactions with experts from the organizational part which delivers service by using on-line chat for instant support, and video call for deeper understanding of addressed issue. Besides, users at this level have possibility to evaluate quality of delivered services by particular organizational part of operations function.

Second layer of the architecture represents operational layer with the purpose of collecting, storing and sorting data of requested services, thus allows adequate allocation of selected service to particular organizational part that should deliver service. Furthermore, it enables storage data after delivered service for further control and analysis.

Third layer of the architecture represents strategic layer which aims to yield an insight into the quality level of delivered services, results of organizational performances, as well as to ensure effective support in decision making using qualitative and quantitative data.

4.3. Selection of new and segregation of core from actual and augmented mass customized services

4.3.1. TURF analysis results for selection of new service line

According to the market requirements, five new services are recognized as significant contributors to the sustainability and thus proposed by the authors of the paper to be further evaluated for operations division catalogue. The evaluation process was performed by 39 experts of the bank, who have selected a combination of proposed services based on the business needs. The results are presented in the following tables. Table 1 encompasses the frequencies at which the objective is achieved for each single service.

Table 1: Frequency table for each single proposed service

Proposed services	Frequency	Frequency (%)
Innovation and development management services	5	13
Strategic and operational planning services	2	5
Change management services	14	36
Reporting services	29	74
Business consulting services	30	77

The following table provides the best combinations obtained from experts' assessment, each time with the reach and the frequency obtained. The reach is the number of end users who intend to use at least one service, while the frequency represents the number of times a service received a maximum score. The results are shown in Table 2.

Table 2: The best combinations for introduction of new services

Service line	Reach	Frequency	Service 1	Service 2	Service 3
Line 1	37	73	Change management services	Reporting services	Business consulting services
Line 2	35	64	Innovation and development management services	Reporting services	Business consulting services
Line 3	35	61	Strategic and operational planning services	Reporting services	Business consulting services
Line 4	34	49	Innovation and development management services	Change management services	Business consulting services
Line 5	34	46	Strategic and operational planning services	Change management services	Business consulting services

Finally, Table 3 depicts a two-way TURF results, derived from the selected service lines.

Table 3: Two-way TURF results

	Line1	Line2	Line3	Line4	Line5	% X
Reach	37	35	35	34	34	
Reach (%)	94.87%	89.74%	89.74%	87.18%	87.18%	
Innovation and development management services		14.29		14.71		40.00
Strategic and operational planning services			5.71		5.88	40.00
Change management services	37.84			41.18	41.18	60.00
Reporting services	78.38	82.86	82.86			60.00
Business consulting services	81.08	85.71	85.71	88.24	88.24	100.00

According to the results from TURF analysis, business consulting services, reporting services and change management services, i.e. Line 1, has the highest score of 94.87%. Therefore, services in Line 1 represent candidates to be included in phase II of decision making for final selection and segregation of core from actual and augmented operations services.

4.3.2. ANP-BOCR results for segregation of core from actual and augmented services

In this phase, the authors of the paper have selected eight (8) existing and three (3) new services to be evaluated using ANP-BOCR multi-criteria method. Pair-comparison is carried out by decision maker of the bank under the study to segregate core from actual and augmented operations services. The results are shown in Table 4.

Table 4: Results from ANP-BOCR model

Name	Ideals	Normals	Raw	Segregation
Domestic and international payment transactions services	1.000	0.128	1.000	Core
Reporting services	1.000	0.128	1.000	Core
Business consulting services	0.800	0.103	0.800	Core
Centralized cheques clearing services	0.800	0.103	0.800	Core
Retail and corporate loan services	0.800	0.103	0.800	Core
Premises maintenance	0.800	0.103	0.800	Core
Trade finance services	0.800	0.103	0.800	Core
Business analysis services	0.600	0.077	0.600	Actual
Procurement services	0.600	0.077	0.600	Actual
Change management services	0.400	0.051	0.400	Augmented
Treasury settlement services	0.200	0.026	0.200	Augmented

According to the results, 64% of selected services are categorized as core, followed by 18% of actual services, while 18% of services are recognized as augmented. Besides, of the three new services from Line 1, which were the subject of evaluation, two have been identified as core services of the bank included in this study.

5. CONCLUSION AND RECOMMENDATIONS

This study aims to shed light the understanding of recently advocated paradigms that will substantially reshape operations management in banking industry in years to come, as a result of mainly external forces that are changing the market at high speed, and consequently put pressure on operations managers in

banking to continuously change its strategic context and competitive dynamics. The fundamental requirement in the evolution process is change of operating models, which imply an introduction and application of appropriate strategies, paradigms and tools towards economic sustainability of an organization. With that in mind, this paper presents an overview of innovative concepts with holistic perspective, i.e. mass customized-lean-agile-fit paradigms, provides a solution for effective support of mass customized-lean-agile-fit operations strategies, and answers on the question what operations management needs to provide to internal and external stakeholders to meet both strategic goals and end users' requirements.

To answer "how" to effectively support mass customized-lean-agile-fit operations strategies in banking, we have developed a conceptual architecture of digital platform for operations services. A conceptual architecture aims to visualize operations activities, reduce complexity and time to market, while links value chain from front to end, in order to effectively provide mass customized services, information and knowledge. The purpose of this platform is to enable continuous optimization, improvement of operations processes by eliminating waste and by allowing a quick respond to changes in demand in terms of both, volume and diversity. Further, taking into account that the major challenge in mass customization paradigm is to determine product offerings, we propose a two-phase approach consisting of Total Unduplicated Reach and Frequency (TURF) analysis to facilitate a choice of new services imposed by market requirements and Analytic Network Process based on BOCR model (ANP-BOCR) to segregate a core from actual and augmented mass customized services.

To sustain in today's highly dynamic and volatile business environment, based on the reviewed literature and the results obtained from the study, this paper draws some recommendations for managers in financial services: (a) Incorporation of integrated mass customization, lean and agile paradigms into the operations strategies, (b) Development of innovative and flexible solutions with established continuous monitoring and measuring of operations performances, (c) Development of smart processes focused simultaneously on the efficiency and effectiveness of banking operations, (d) Adoption of comprehensive, quantitative, and objective approach to decision-making with the development of a systematic, logical and ambidextrous view on the problem, and (e) The use of appropriate tools and decision support software solutions (Čupić & Suknović, 2010).

The study may be useful for operations managers in financial services, innovation, IT and business decision management.

REFERENCES

AlukaJ, G. (2003). Create a lean, mean machine.

Brown, S., Bessant, J. R., & Lamming, R. (2013). Strategic operations management. Routledge.

Bruce, M., Daly, L., & Towers, N. (2004). Lean or agile: a solution for supply chain management in the textiles and clothing industry?. *International journal of operations & production management, 24*(2), 151-170.

Ciegis, R., Ramanauskiene, J., & Martinkus, B. (2009). The concept of sustainable development and its use for sustainability scenarios. *Inzinerine Ekonomika-Engineering Economics*, (2), 28-37.

Christopher, M. (2000). The agile supply chain: competing in volatile markets. *Industrial marketing management, 29*(1), 37-44.

Čupić M., & Suknović M. (2010). *Odlučivanje*. Belgrade, Faculty of Organizational Sciences.

Dahlgaard, J. J., & Mi Dahlgaard-Park, S. (2006). Lean production, six sigma quality, TQM and company culture. *The TQM magazine*, *18*(3), 263-281.

De Koning, H., & De Mast, J. (2006). A rational reconstruction of Six-Sigma's breakthrough cookbook. *International Journal of Quality & Reliability Management*, *23*(7), 766-787.

De Koning, H., Does, R. J., & Bisgaard, S. (2008). Lean Six Sigma in financial services. *International Journal of Six Sigma and Competitive Advantage, 4*(1), 1-17.

De Treville, S., & Antonakis, J. (2006). Could lean production job design be intrinsically motivating? Contextual, configurational, and levels-of-analysis issues. *Journal of Operations Management, 24*(2), 99-123.

Droste, A. (2007). Lean thinking, banish waste and create wealth in your corporation.

Fasnacht, D. (2009). *Open Innovation in the financial services: Growing through openness, flexibility and customer integration*. Springer.

Gilmore, J. H., & Pine, B. J. (1997). The four faces of mass customization. *Harvard business review*, *75*, 91-101.

Gunasekaran, A., & Ngai, E. W. (2012). The future of operations management: an outlook and analysis. *International Journal of Production Economics*, *135*(2), 687-701.

Henderson, J. C., & Venkatraman, H. (1999). Strategic alignment: Leveraging information technology for transforming organizations. *IBM systems journal*,*38*(2/3), 472.
Hines, P., Holweg, M., & Rich, N. (2004). Learning to evolve: a review of contemporary lean thinking. *International journal of operations & production management*, *24*(10), 994-1011.
Hoekstra, R., & Nahmens, I. (2005). An Integrated Interior Infill System for Mass Customized Housing: Final Report.
Hopp, W. J., & Spearman, M. L. (2004). To pull or not to pull: what is the question?. *Manufacturing & service operations management, 6*(2), 133-148.
Huang, X., Kristal, M. M., & Schroeder, R. G. (2008). Linking learning and effective process implementation to mass customization capability. *Journal of Operations Management*, *26*(6), 714-729.
Huo, J., & Hong Z. (2013). *The Rise of Service Science.* In Service Science in China. Berlin Heidelberg: Springer.
Jiliberto, H. R. (2003). Models for Regional Sustainability Assessment: the case of the region of Murcia, Spain. *In Workshop* (Vol. 3, pp. 11-13).
Khalili-Araghi, S., & Kolarevic, B. (2016). Development of a Framework for Dimensional Customization System: A Novel Method for Customer Participation. *Journal of Building Engineering.*
Kriščiūnas, K., & Daugėlienė, R. (2015). The assessment models of knowledge-based economy penetration. *Engineering Economics*, *50*(5).
Lacy, P., Cooper, T., Hayward, R., & Neuberger, L. (2010). A new era of sustainability. *UN Global Compact, Accenture.*
Lester, R. I. (2008). Lean Thinking: Banish Waste and Create Wealth in Your Corporation. *Air & Space Power Journal, 22*(2), 103-105.
Leyer, M., & Moormann, J. (2014). How lean are financial service companies really? Empirical evidence from a large scale study in Germany. *International Journal of Operations & Production Management*, *34*(11), 1366-1388.
Liang, C., & Li, Q. (2008). Enterprise information system project selection with regard to BOCR. *International Journal of Project Management*, *26*(8), 810-820.
MacCarthy, B., Brabazon, P. G., & Bramham, J. (2003). Fundamental modes of operation for mass customization. *International Journal of Production Economics*, *85*(3), 289-304.
Mann, D. (2014). *Creating a lean culture: tools to sustain lean conversions.* CRC Press.
Mefford, R. N. (1993). Improving service quality: learning from manufacturing. *International Journal of Production Economics*, 30, 399-413.
Nagel, R. N., & Dove, R. (1991). *21st century manufacturing enterprise strategy: An industry-led view*. Diane Publishing.
Naylor, J. B., Naim, M. M., & Berry, D. (1999). Leagility: integrating the lean and agile manufacturing paradigms in the total supply chain. *International Journal of production economics, 62*(1), 107-118.
NBS. (2015). *Bilans stanja i uspeha banaka.* Retreived from: http://www.nbs.rs/internet/cirilica/50/50_5.html.
Ohno, T. (1988). *Toyota production system: beyond large-scale production.* crc Press.
Pham, D. T., & Thomas, A. (2005). Fighting fit factories: making industry lean, agile and sustainable. *Manufacturing Engineer, 84*(2), 24-29.
Pham, D. T., & Thomas, A. J. (2011). Fit manufacturing: a framework for sustainability. *Journal of Manufacturing Technology Management, 23*(1), 103-123.
Papathanassiou, E. A. (2004). Mass customisation: management approaches and internet opportunities in the financial sector in the UK. *International Journal of Information Management*, *24*(5), 387-399.
Pine, B. J., Peppers, D., & Rogers, M. (1995). *Do you want to keep your customers forever?*. Harvard Business Press.
Power, D. J., Sohal, A. S., & Rahman, S. U. (2001). Critical success factors in agile supply chain management-An empirical study. International *Journal of Physical Distribution & Logistics Management, 31*(4), 247-265.
Propa, G., Banwet, D. K., & Goswami, K. K. (2015). Sustainable Operation Management Using the Balanced Score Card as a Strategic Tool-A Research Summary. *Procedia-Social and Behavioral Sciences*, *189*, 133-143.
Rother, M. (2009). *Toyota Kata: managing people for improvement, adaptiveness and superior results*. McGraw-Hill Professional.
Saaty, T. (2009). Applications of analytic network process in entertainment. *Iranian Journal of Operations Research, 1*(2), 41-55.
Saaty, T., & Özdemir, M. S. (2005). *The encyclicon: a dictionary of applications of decision making with dependence and feedback based on the analytic network process*. RWS Publications.
Saaty, T., & Vargas, L. G. (2001). *Models, methods, concepts & applications of the analytic hierarchy process* (Vol. 1, p. 46). Boston: Kluwer Academic Publishers.
Serra, D. (2013). Implementing TURF analysis through binary linear programming. *Food Quality and Preference, 28*(1), 382-388.

Shah, R., & Ward, P. T. (2007). Defining and developing measures of lean production. *Journal of operations management, 25*(4), 785-805.
Slack, N., Lewis, M., & Bates, H. (2004). The two worlds of operations management research and practice: can they meet, should they meet?. *International Journal of Operations & Production Management, 24*(4), 372-387.
Slack, N. (2015). Operations strategy. John Wiley & Sons, Ltd.
Sprogies, M., & Schmidt, W. (2015). Introducing S-BPM at an IT Service Providers. In *S-BPM in the Wild* (pp. 55-74). Springer International Publishing.
Staats, B. R., Brunner, D. J., & Upton, D. M. (2011). Lean principles, learning, and knowledge work: Evidence from a software services provider. *Journal of Operations Management, 29*(5), 376-390.
Staikouras, C. K., & Koutsomanoli-Fillipaki, A. (2006). Competition and concentration in the new European banking landscape. *European Financial Management*, *12*(3), 443-482.
Tornjanski, V., Marinković, S. & Lalić, N. (2014). Application of ANP method based on a BOCR model for decision-making in banking. *Proceedings of the XIV International Symposium SymOrg: New business models and sustainable competitiveness (SYMORG 2014)*, Zlatibor, Serbia.
Tornjanski, V., Marinkovic, S., Levi Jaksic, M., & Bogojevic Arsic, V. (2015a). The prioritization of open innovation determinants in banking. *Industrija*, *43*(3).
Tornjanski, V., Marinković, S., Săvoiu, G., & Čudanov, M. (2015). A Need for Research Focus Shift: Banking Industry in the Age of Digital Disruption. *Econophysics, Sociophysics & Other Multidisciplinary Sciences Journal (ESMSJ), 5*(3), 11-15.
Tseng, M. M., & Hu, S. J. (2014). Mass customization. In *Cirp Encyclopedia of Production Engineering* (pp. 836-843). Springer Berlin Heidelberg.
Tseng, M.M., & Jiao, J. (2001). Mass Customization. In *G. Salvendy (Ed.) Handbook of Industrial Engineering*, 3rd edition, New York, Wiley, 684-709.
Vinodh, S., Sarangan, S., & Vinoth, S. C. (2014). Application of fuzzy compromise solution method for fit concept selection. *Applied Mathematical Modelling, 38*(3), 1052-1063.
Weill, P., & Woerner, S. L. (2015). Thriving in an increasingly digital ecosystem. *MIT Sloan Management Review*, *56*(4), 27.
Womack, J. P., & Jones, D. T. (1996). Lean thinking: Banish waste and create wealth in your organization. *Simon and Shuster, New York, NY*, 397.
Womack, J. P., & Jones, D. T. (2010). *Lean thinking: banish waste and create wealth in your corporation*. Simon and Schuster.
Zangiski, M. A. D. S. G., de Lima, E. P., & da Costa, S. E. G. (2013). Organizational competence building and development: Contributions to operations management. *International Journal of Production Economics, 144*(1), 76-89.
Zhao, X., & Lee, T. S. (2009). Developments and emerging research opportunities in operations strategy and supply chain management. *International Journal of Production Economics, 120*(1), 1-4.

APPLICATION OF THE GAMES IN TEACHING LOGISTICS AND SUPPLY CHAIN MANAGEMENT IN THE REPUBLIC OF SERBIA

Biljana Cvetić*[1], Nemanja Milenković[1]
[1]University of Belgrade, Faculty of Organizational Sciences
*Corresponding author, e-mail: cvetic.biljana@fon.bg.ac.rs

Abstract: *This research paper examines the current state of the application of the educational games in teaching logistics and supply chain management (SCM) in higher education institutions in the Republic of Serbia. The data for the study were collected from competent teaching staff through a questionnaire administered on-line using Qualtrics Research Suite. The results of the study show that educational games are not used to a great extent in teaching logistics and SCM at faculties in the Republic of Serbia. The most common reason for this lies in that teaching staff is not sufficiently familiar with the logistics and SCM games. At the same time, the results reveal the ubiquitous interest of the teaching staff for games introduction into the teaching of logistics and SCM. When it comes to the teaching scholars who use educational games, the results show that educational games are equally used at the state and private faculties and that the teachers are satisfied with the possibilities of improving students' competences with the use of games.*

Keywords*: logistics, supply chain management, educational games, application, questionnaire, faculties, Republic of Serbia*

1. INTRODUCTION

The application of educational games in synergy with other teaching methods is one of the perspective ways to enhance teaching and learning in the field of logistics and supply chain management. Most teachers of logistics and supply chain management from several leading institutions of higher education in the US use at least one game, simulation and/or interactive exercise in addition to other teaching methods such as lectures and case studies (according to Johnson and Pyke, 2000). Also, most teachers across the world who teach logistics and SCM would like to use business games/simulations in future (according to study by Rogers and Braziotis, 2016, p. 557). Much of the literature on logistics and SCM games is focused on the development and/or use of specific games; whereby the majority of papers is concerned with the most famous of them – Beer Game and their different versions (e.g. Sterman, 1989; Jacobs, 2000; Ngai et al., 2012; Lau, 2015). However, there is a little empirical evidence on the extent of the use of educational games in teaching logistics and SCM within the higher education institutions. The purpose of this paper is to examine the current state of the application of the educational games in teaching logistics and SCM in higher education institutions in the Republic of Serbia. The study is based on the findings of an on-line questionnaire sent to competent teaching staff working on faculties in Serbia.

2. THEORETICAL BACKGROUND

There are a number of educational games that can be employed in teaching logistics and SCM courses. They simulate the realities of a particular logistics or supply chain management problem, "allowing the students (players) to develop a thorough understanding of the problem and to design and test various solution strategies in an engaging environment" (according to Cambel et al., 2000, p. 68). These games allow students to learn through playing different roles, e.g. an inventory manager, a logistics engineer, a distribution network designer, a supply chain engineer, a supply chain manager, etc., in an environment 'without real risks' that consists of virtual entities (Cvetić et al., 2013, p. 1527). Students can compete individually and as a team memebers, with each other or against the standard, as in other games, and make learning and acquiring experience more interesting. The logistics and SCM educational games are very useful because they can enhance learning experience as they help connect learning theory with real-world dynamic situations; they improve students' active involvement in the learning process; increase students' motivation, and develop specific fundamental and professional competences (Pasin and Giroux, 2011). A brief historical background about these games and several ways of their classification are presented in Cvetić et al., 2013. When it comes to the empirical studies on their usage in teaching logistics and SCM in institutions of higher education, the available literature is almost scarce and slightly wider context should be considered i.e. the usage of business simulation games. Here, only two such studies are indicated. Faria and Wellington (2004) examine the game users, former-users, and never-users of businees simulation games in

higher education business schools in the US. Zoroja (2013) investigates the application of business simulation games at the economics departments of higher education institutions in Croatia.

3. METHODOLOGY

The study of the application of the educational games in teaching logistics and SCM at faculties in the Republic of Serbia was conducted during October and November of 2013. The main aim of the study was to determine and understand the level of application of the logistics and SCM games at faculties in the Republic of Serbia. Additionally, other important objectives were to identify the reasons why some teachers do not use these games, to determine the level of interest of teaching staff for games introduction into the teaching process, to determine which games are used in teaching, as well as to reveal the perceived possibility of improvement of students' competences by using the games.

Accordingly, the aim of the study was to test the following hypotheses:

- educational games are not used to a great extent in teaching logistics and SCM at faculties in the Republic of Serbia;
- the teachers that use games in teaching logistics and SCM are satisfied with the possibilities of improving students' competences with the use of the games;
- the teachers are not familiar with the logistics and SCM games; and
- the teachers are interested in the application of games in teaching logistics and SCM.

The study was conducted in the following seven phases:

1. Determination of population of teaching staff in the field of logistics and SCM at faculties in the Republic of Serbia;
2. Identification of risks related to the study and ways of their mitigation and/or overcoming;
3. Creation of Questionnaire on the application of educational games in teaching logistics and SCM at faculties in the Republic of Serbia;
4. Selection of method of sending the questionnaires and collecting the completed questionnaires;
5. Design of Questionnaire by selected tool;
6. Sending the invitations for participation in the survey and collecting the completed questionnaires; and
7. Analysis of results.

In the first phase, the data about the population of teaching staff in the field of logistics and SCM within the accredited study programs at universities and faculties in the Republic of Serbia were collected. In that sense, different documents and data were used, such as: "Guide through accredited study programs in the institutions of higher education in the Republic of Serbia" published by the Serbian Commission for Accreditation and Quality Assurance (CAQA) in 2013, "The list of accredited faculties and universities" published by the Ministry of Education, Science and Technological Development in 2013, the data from the official websites of higher education institutions and the data from direct contact with the representative of one faculty. The total of 16 accredited universities (8 state and 8 private universities), and within them 114 accredited faculties and 5 integrated universities, were considered. After consideration, it was determined that at 26 faculties there are courses in the field of logistics and SCM (15 state and 11 private faculties), with that the total of 70 teaching staff (44 teachers and 26 teaching assistants) are engaged in teaching these courses. Then, the data about teaching staff were collected (the title, the first and last name(s), and the official e-mail address).

In the second phase, the specific risks related to conducting the study were identified and named: distrust of respondents, the disinterest of respondents, the busyness of respondents, and disturbing of respondents (see Table 1). Next, the ways of mitigation and/or overcoming these risks were determined in order to provide a higher response rate.

In the third phase, the Questionnaire on the application of educational games in teaching logistics and SCM at faculties in the Republic of Serbia was created. The attention was given to the aims of the study and hypotheses; to the specific requirements about an appropriate number of relevant, clear, and short questions; to using open-ended response questions and fixed-alternative questions; to grouping questions, etc. The recommendations given in Zikmund et al, 2010, p. 337-352, were very useful during this phase of the study. The final version of Questionnaire was organized into the following five parts: 1. Introduction part; 2. The part called "Teaching in the field of logistics and SCM"; 3. "Educational games in teaching logistics and SCM"; 4. "Application of educational games in teaching logistics and SCM"; and 5. Final part of Questionnaire. At the end, the Questionnaire was technically and professionally checked.

In the fourth phase, the method of sending the questionnaires and collecting the completed questionnaires was chosen. First, it was decided to use an on-line questionnaire and accordingly to electronically collect the filled-in questionnaires. Then, several tools which enable the use of on-line questionnaires were considered, like Google Forms (https://docs.google.com/forms), SurveyMonkey (https://www.surveymonkey.com), SurveyGizmo (http://www.surveygizmo.com), Qualtrics Research Suite (http://www.qualtrics.com), etc. Finally, the Qualtrics Research Suite was selected based on good recommendations from several researchers (Zikmund, et al., 2010; Machado, 2012), price and attractiveness of different options (about 100 types of questions, the user can manage the activation of questionnaire, use of the Serbian language, redirection of questions based on answers, a possibility for respondents to take a break during the process of responding, use of visual indicator about completion of questionnaire, good options for visual design of questionnaire, easy collecting of data).

Table 1: Ways of overcoming risks related to conducting the study

Risks	Ways of overcoming risks
Distrust of respondents	– sending the personalized invitation for participation in the study with a carefully chosen subject of the e-mail – providing the highest possible level of anonymity of respondents
Disinterest of respondents	– providing a prize for respondents – sending the clear and short invitations for participation in the study – pointing out to the time required for completion of the questionnaire – making clear and short questions – using open-ended response questions at the beginning of the questionnaire in order to focus respondents on the questioning process (recommendation adopted from Zikmund et al, 2010, p. 338)
Busyness of respondents	– using on-line questionnaires – providing respondents to complete the questionnaire in a short period of time – providing respondents to take a break during the process of completion of the questionnaire – providing respondents the possibility to see the level of completion of the questionnaire, with a status bar or some other visual indicator of questionnaire length (recommendation adopted from Zikmund et al, 2010, p. 356-357) – making the appropriate number of relevant, clear and short questions – organizing the questions in several groups according to the topics – providing respondents to receive the invitations for participation in the study on Monday morning – limiting the horizontal visibility of questionnaire because of its display on different versions of the web browser – displaying the questionnaire page by page and avoiding that respondent need to scroll through the questionnaire (Zikmund et al, 2010, p. 356-357) – limiting the process of questioning to the previously defined number of days
Disturbing of respondents	– exclusively sending 1 invitation for participation in the survey by e-mail

In the fifth phase, the Questionnaire was designed and tested with the help of the Qualtrics Research Suite. One part of the Questionnaire is given in Figure 1.

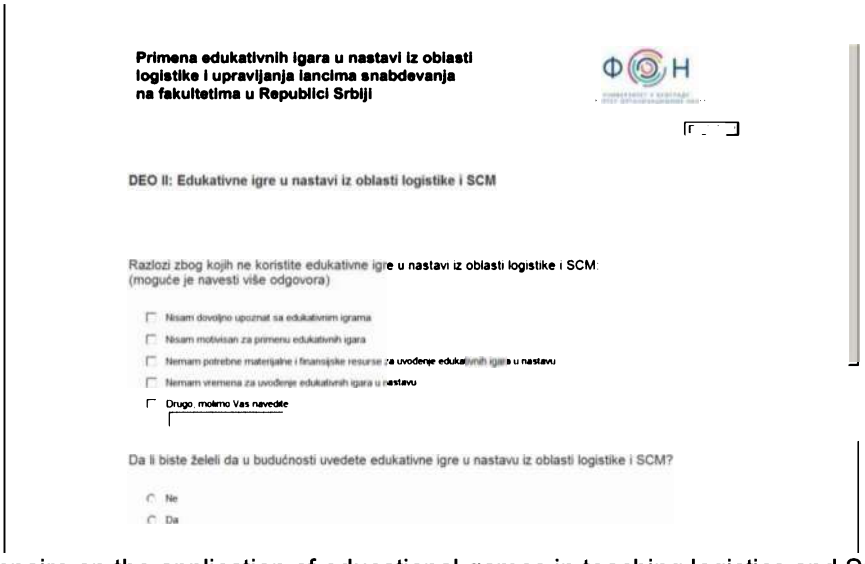


Figure 1: Questionnaire on the application of educational games in teaching logistics and SCM at faculties in the Republic of Serbia **(one part)**

In the sixth phase, the Questionnaire was activated and then the personalized invitations for participation in questioning were sent from the author' personalized e-mail address. The invitations were sent only one time because of the potential disturbance of respondents. During this process, sending of one invitation was unsuccessful, even after multiple attempts. Included in the invitation was a brief explanation of the study and a statement that participants in questioning will get a database of 55 logistics and SCM educational games as a prize. The Questionnaire was active 25 days, and during this time, the completed questionnaires were automatically collected.

In the seventh phase, the analysis of results was done. In doing so, the questions with multiple responses were analyzed by Multiple Response Analysis (MRA), and more precisely with the Multiple-Dichotomy Method because of the type of the used questions. Also, non-parametric statistical tests were used because of a small number of respondents (and consequently – inadequacy to testing the normality of the distributions of the used variables). The analyzes are all done by the help of tools MS Excel and SPSS Statistics 17.0.

4. RESULTS OF STUDY

The population of teaching staff in the field of logistics and SCM at faculties in the Republic of Serbia consisted of 70 teachers and teaching assistants who work within 26 accredited faculties. The invitations for participation in questioning are successfully sent to 69 teachers and teaching assistants. The total of 32 completed questionnaires is collected from teaching staff of 17 different faculties. Therefore, the response rate of teaching staff is 46.38%, and is considered acceptable. It is interesting to mention that the response rate of teachers (51.16%) is higher than the response rate of teaching assistants (38.46%).

More than half of teaching staff that participates in the survey (54.55%) have experience between 3 and 8 years in teaching logistics and SCM courses. About 10% of teachers from state faculties who teach logistics courses for more than 20 years, as well as about 10% of teachers from private faculties who teach in this field less than 3 years were among respondents.

All respondents use traditional teaching methods such as lectures and discussions, as it was expected; and 15.63% of them use only this method. Then, 68.75% of respondents use case studies; 43.75% of respondents use simulations; and exactly half of the respondents (50%) use simulations and/or educational games in combination with other teaching methods. In addition to the offered teaching methods, the respondents mentioned tutorials and mentoring work with students, visits to the Free zone and relevant companies.

Only about one-fifth of the respondents (18.75%) stated that they used educational games, and thus, it can be generally concluded that educational games are not used to a great extent in teaching logistics and SCM at faculties in the Republic of Serbia. The respondents who use games work at 5 different state and private faculties. There was no statistically significant difference between the game users of state and private faculties (Fisher's exact test: $p(2\text{-sided})=0.063$), i.e. games are equally used both at the state and private faculties.

The respondents-non-users of games cited during the questioning several reasons why they do not use educational games in teaching logistics and SCM. These are:

1. lack of familiarity with educational games;
2. lack of required material and financial resources for games introduction into teaching;
3. lack of time for game introduction into teaching;
4. the little interest of students, in the sense that most students are only interested how to "arrive" at the desired grade;
5. lack of motivation for applying educational games;
6. lack of agreement between teachers and teaching assistants in relation to using games, wherein the problem is participation scoring;
7. a view that learning should be a hard and serious job, so there is no need for games introduction; and
8. An insufficient number of teaching assistants.

The four of these reasons were offered, and the other four were identified based on respondents' responses. Respondents gave a total of 41 reasons, which indicates that more than half of the respondents stated more than 1 reason.

The two most common reasons why respondents do not use educational games in teaching logistics and SCM are:

1. lack of familiarity with educational games according to 61.54% of respondents; and
2. lack of required material and financial resources for games introduction into teaching according to 42.31% of respondents.

The reason of lack of familiarity with educational games was given by 57.90% of teachers and 71.43% of teaching assistants (no statistically significant difference was found, Fisher's exact test: *p(2-sided)*=0.668), (see Table 2). This same reason was stated by 65.22% of respondents from state faculties and 33.33% of respondents from private faculties (also, no statistically significant difference was found, Fisher's exact test: *p(2-sided)*=0.538).

The reason of lack of required material and financial resources for games introduction into teaching was stated by 47.37% of teachers and 28.57% teaching assistants (no statistically significant difference was found, Fisher's exact test: *p(2-sided)*=0.658). Also, this reason was stated by 43.48% respondents from state faculties and 33.33% respondents from private faculties (no statistically significant difference was found, Fisher's exact test: *p(2-sided)*=1.000), see Table 2.

Table 2: The two most common reasons why respondents do not use games

	The two most common reasons why respondents do not use educational games in teaching logistics and SCM at faculties in the Republic of Serbia (*N*=26)		
	N	Lack of familiarity with educational games	Lack of required material and financial resources
Teaching staff			
Teachers	19	11	9
Teaching assistants	7	5	2
Fisher's exact test		0.668	0.658
Faculties			
State faculties	23	15	10
Private faculties	3	1	1
Fisher's exact test		0.538	1.000

*significant for $p<0.05$; **significant for $p<0.01$

It is interesting that all respondents who do not use educational games in teaching logistics and SCM stated that they would like to introduce educational games in teaching in this field in future, except one respondent who did not want to answer this question.

A small number of respondents uses games in teaching logistics and SCM at faculties in the Republic of Serbia (*N*=6), as we previously concluded. They use 2 games in average (*N*=6; mean *M*=2.33; standard deviation *SD*=1.21). From the answers, it can be seen that both manual and computer versions of games are in use; mostly free games, but also games that cost more than 450 Euros; most games are already developed by others, as well as new games developed according to their own needs. All respondents-users of games in teaching indicated that the games positively influence on the interest in courses. Furthermore, these respondents were asked to rate how much it is easy or difficult to improve certain fundamental competences of students by using games on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). In that sense, they evaluated the following competences: solving problems, decision making, planning and organizing of tasks, communication, and team-work. The selected results are presented in the form of radar chart in Figure 2. These results show that the observed teachers are satisfied with the possibilities of improving students' competences with the use of games.

A half of respondents (*N*=16) gave additional comments on the application of games in teaching logistics and SCM. Their comments are divided into three groups:

- positive comments – that point out the advantages of using games in teaching;
- constructive comments – that give useful suggestions in relation to the use of games in teaching; and
- comments of non-supporters of the games – that observe the use of games as unnecessary and/or useless activity.

Thus, ten comments are classified in the group of positive comments (62.50%), five in the group of constructive comments (31.25%), and one in the group of comments of non-supporters of the games (6.25%).

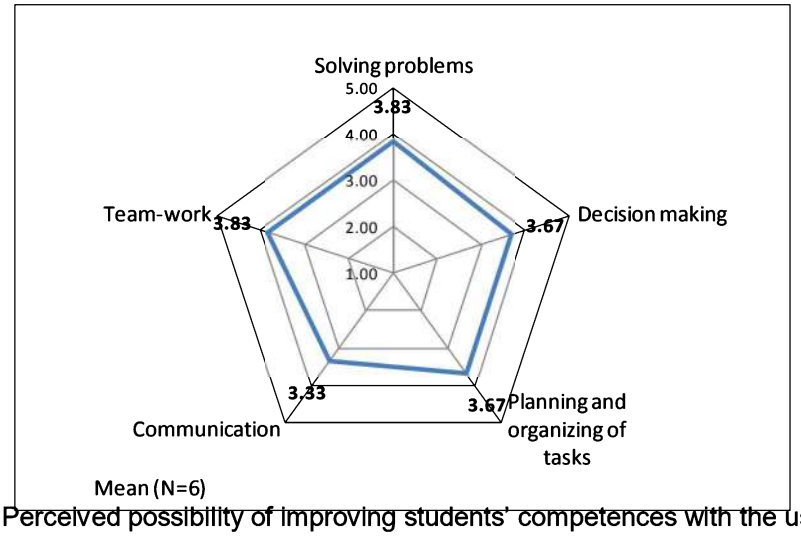


Figure 2: Perceived possibility of improving students' competences with the use of games

Finally, 84.38% of participants were interested in getting a database of 55 logistics and SCM games.

5. DISCUSSION OF RESULTS

In this study on the application of the logistics and SCM games, 46.38% of competent teaching staff from the higher education institutions in the Republic of Serbia participated. The obtained response rate is considered acceptable based on specifics of populations, which can be justified by considerations and data given in Neuman (1997), Chang (2003), Faria and Wellington (2004), Lean et al. (2006), and Zoroja (2013). Thus, according to Neuman (1997), p. 247, the adequate response rate presents the assessment which depends on population, practical limitations, topics and answers with which researchers feel comfortable so that the response rates less than 50% can be accepted. Moreover, in some of the previous studies on using simulations and/or games in teaching (such as Chang, 2003; Faria and Wellington, 2004; Lean et al., 2006; and Zoroja, 2013), the adequate response rates were less than 25%. Hence, it can be generally concluded that the teaching staff is a specific population not much interested in participating in studies of this type.

The results of this study confirm that educational games are not used to a great extent in teaching logistics and SCM at faculties in the Republic of Serbia. Only around one-fifth of the respondents (18.75%) actually use games in teaching in this field. Additionally, an interesting fact is that exactly half of the respondents (50%) use simulations and/or educational games in combination with other teaching methods. This data is very different from the conclusion expressed in Johnson and Pyke (2000) – that most teachers use at least one game, simulation and/or interactive exercise in addition to other teaching methods for teaching logistics and SCM. However, this conclusion was derived based on analysis of courses from the several leading institutions of higher education in the US. On the other hand, if the data was considered from the wider context i.e. compared to users of business simulation games (studies like Faria and Wellington, 2004; Zoroja, 2013), they could be positively interpreted. Thus, according to Faria and Wellington (2004), 30.6% of teaching staff from the higher education business schools in the US use business simulation games (study conducted in 2003). The study from Croatia conducted in 2012 shows that 26.32% of teaching staff from the business and economics departments of higher education institutions in this country are users of business simulation games (Zoroja, 2013).

The results show that the teachers who use games in teaching are satisfied with the possibilities of improving students' competences with the use of games. Here, it should be acknowledged that this conclusion is derived based on a small number of respondents who use games. The aforementioned reason also limits the consideration of using manual vs. computer versions of games, free games vs. commercial games, and similar comparisons.

The results of the study confirm that teaching staff is not sufficiently familiar with the logistics and SCM games. This reason was stated by more than half of respondents (61.54%). Of course, this can be closely connected with the small number of respondents-users of games, as Faria and Wellington (2004), p. 198, pointed out that it is difficult to be a game user if one is not familiar with games. The other reasons of non-users of games were: a lack of required material and financial resources for games introduction into

teaching, a lack of time for game introduction into teaching, a perceived little interest of students, etc. We believe that the identification and understanding of these reasons are important for future activities in the sense of their mitigation/overcoming. At the same time, the findings show the ubiquitous interest of the teaching staff for games introduction into the teaching of logistics and SCM at faculties in the Republic of Serbia. The analysis of comments confirms that teaching staff has positive attitudes to the use of games in the teaching process.

While the data for this study is derived from a population-based questioning, it is important to note obvious limitations to the generalizability of the findings. The population of teaching staff from the field of logistics and SCM in the Republic of Serbia was small. Additionally, the response rate to the questionnare was 46.38% and the group of respondents-users of logistics and SCM games were under-represented.

6. CONCLUSION

This is one of the first empirical studies of the application of educational games in teaching logistics and supply chain management which has been conducted in the Republic of Serbia. The study answers the following questions: "What is the level of application of the logistics and SCM games at faculties in the Republic of Serbia?", "Are the teaching staff satisfied with the effects of using the games?", "What are the reasons for not using the games in teaching?", "Is the teaching staff interested in introducing games in teaching logistics and SCM?", and some other issues that are not covered in this paper. One of the main findings of this study that there is a large number of teaching scholars who not use logistics and SCM games in the Republic of Serbia, probably most of all due to a lack of familiarity with these games and of course the other reasons, is not surprising. This suggests a need for further investigation of the effectiveness of using games in logistics and SCM courses. We believe that more empirical studies about the effects of employing games in addition to the other teaching methods could stimulate an interest in games amongst teaching staff currently not familiar with them. Additionally, the development of methods of the selection of games and tools like DST SLSCMG (Decision Support Tool for the Selection of Logistics and Supply Chain Management Games) (see Cvetić et al., 2013), then development and application of a new frameworks or models of learning logistics and SCM based on games (such as those presented in Lewis and Maylor, 2007; Huang et al., 2008), can be useful to current and potential logistics and SCM game users.

REFERENCES

Campbell, A., Goentzel, J. & Savelsbergh, M. (2000) Experiences with the use of supply chain management software in education. *Production and Operations Management*, *9*(1), 66-80.

Chang, J. (2003) Use of business simulation games in Hong Kong. *Simulation & Gaming*, *34*(3), 358-366.

Cvetić, B., Vasiljević, D. & Mijatović, I. (2013) Design and application of a Decision Support Tool for the Selection of Logistics and Supply Chain Management Games. International Journal of Engineering Education, *29*(6), 1527–1536.

Faria, A. J. & Wellington, W. J. (2004) A survey of simulation game users, former-users, and never-users. *Simulation & Gaming*, *35*(2), 178-207.

Huang, X., Ashenbaum, B., Finch, B., Newman, W. & Salzarulo, P. (2008) Using game to promote student learning in supply chain and operations management. Proposal for TOP25 Project: Engaging students in their learning. Retrieved from http://www.units.muohio.edu/celt/engaged_learning/top25/proposals/round2/MGT302.pdf, (28/02/2013)

Jacobs, F. R. (2000) Playing the beer distribution game over the internet. *Production and Operations Management*, *9*(1), 31-39.

Johnson, M. E. & Pyke, D. F. (2000) A framework for teaching supply chain management. *Production and Operations Management*, *9*(1), 2-18.

Lau, A. K. (2015) Teaching supply chain management using a modified beer game: an action learning approach. *International Journal of Logistics Research and Applications*, *18*(1), 62-81.

Lean, J., Moizer, J., Towler, M. & Abbey, C. (2006) Simulations and games: use and barriers in higher education. *Active Learning in Higher Education*, *7*(3), 227-242.

Lewis, M. A. & Maylor, H. R. (2007) Game playing and operations management education. *International Journal of Production Economics*, *105*(1), 134–149.

Machado, C. (2012) Qualtrics research suite in academic context. *Revista Onis Ciencia*, Braga, *1*(2), 32-53.

Ministry of Education, Science and Technological Development (2013) "The list of accredited faculties and universities". (in Serbian) Retreived from http://www.nsz.gov.rs/live/digitalAssets/1/1293_akreditovani_fakulteti_i_univerziteti__2013_.pdf (11/09/2013)

Neuman, W. L. (1997) *Social Research Methods: Qualitative and Quantitative Approaches* (3rd ed.), Allyn and Bacon, Boston, US.

Ngai, E. W., Moon, K. K. L. & Poon, J. K. (2012) Design and implementation of a Supply Chain Learning Platform. *Journal of Educational Computing Research*, *47*(3), 293-327.

Pasin F. & Giroux, H. (2011) The impact of a simulation game on operations management education. *Computers and Education*, *57*(1), 2011, 1240–1254.

Rogers, H., & Braziotis, C. (2016) Current issues in teaching logistics management. In *Dynamics in Logistics* (Eds. Kotzab, H., Pannek, J. & Thoben, K.-D.), 553-563. Springer International Publishing.

Serbian Commission for Accreditation and Quality Assurance (2013) "Guide through accredited study programs in the institutions of higher education in the Republic of Serbia", version from 5th July 2013. (in Serbian) Retreived from http://www.kapk.org/images/stories/Vodic-05-07-2013.pdf (11/09/2013)

Sterman, J. D. (1989) Modeling managerial behavior: misperceptions of feedback in a dynamic decision making experiment. *Management Science*, *35*(3), 321-339.

Zikmund, W. G., Babin, B. J., Carr, J. C. & Griffin, M. (2010) *Business Research Methods* (8th ed.), South-Western, Cengage Learning, Canada.

Zoroja, J. (2013) Usage of business simulation games in Croatia: perceived obstacles. *Managing Global Transitions*, *11*(4), 409-420.

PROJECT MANAGEMENT 1065

COMPETENCES OF THE PROJECT MANAGERS IN RELATION TO THE TYPE OF PROJECT 1066
Petrović Dejan, Mihić Marko, Obradović Vladimir

KNOWLEDGE SHARING IN PROJECT ENVIRONMENT 1074
Todorović Marija, Toljaga-Nikolić Danijela, Mitrović Zorica

MATURITY MODEL COMPARATIVE ANALYSIS: OPM3 VS. IPMA DELTA MODEL 1081
Bjelica Dragan, Mitrović Zorica, Todorović Marija

SUSTAINABILITY AND PROJECT MANAGEMENT – WHERE IS THE LINKAGE? 1088
Toljaga-Nikolić Danijela, Todorović Marija, Bjelica Dragan

PROJECT MANAGEMENT

COMPETENCES OF THE PROJECT MANAGERS IN RELATION TO THE TYPE OF PROJECT

Dejan Petrović*, Marko Mihić, Vladimir Obradović
Faculty of Organizational Sciences, Belgrade
*Corresponding author, e-mail: dejan.petrovic@fon.bg.ac.rs

Abstract: *The paper considers competencies of contemporary project manager in relation to the type of project. The paper starts with an analysis of project types and their influence on project management approach. Competent factors of a project manager are divided and considered in the three separate groups: factors of technical competences, factors of behavioral competences, and factors of contextual competences. The importance of the project manager competencies is connected to the type of the project. The last part of the paper analyses competencies of project manager and project types. The assessment of contemporary project manager competencies should show us directions of further improvement of project manager.*

Keywords*: project manager, project type, technical, behavioral and contextual competencies*

1. INTRODUCTION

Presently, a great variety of different approaches to project management exist. All of these have been developed with the intention of using the previous experiences in project management and applying adequate procedures, methods, and techniques so that the project is implemented in line with the desired objectives. Among the world renowned organizations involved in the development of project management approaches and gathering numerous professionals in the area are IPMA – International Project Management Association and PMI – Project Management Institute. A special feature of the contemporary project management is the use of specialized software tools for project management (Microsoft Office Project, Primavera Professional Project Management …) which are practically indispensable for management of any complex projects.

The role and the position of a project manager are of special significance for the functioning of a project. The project manager is fully responsible for ensuring that the project is implemented in line with the schedule, budget, and quality. But the competencies of the project managers depend on the type of project.

2. ORGANIZATION AND PROJECT TYPE

From the project point of view, organizations can generally be divided into two groups relative to their attitude towards projects:

- Project oriented organizations,
- Organizations which are not project oriented.

Project oriented organizations carry out each of their operations in line with the principles of project organization. This group of organizations includes: construction companies, project design organizations, contracting companies, scientific and research organizations, consultancy companies, aircraft manufacturers, shipbuilding companies, manufacturers of large equipment and plants, marketing agencies, software companies, design centers, military industry and many others.

Organizations which are not project oriented do not perform all of their tasks in line with project management principles, but can nevertheless organize a number of their activities as projects: marketing of new products, research and development of new products and services, construction of new capacities, introduction of new information technology systems, reorganization of the company, capacity building, organization of annual shareholder meeting, moving of the offices, production for a known buyer, and quite a number of other operations. Some researches indicate that up to 50% of the operations of such companies are carried out as projects.

One of the easiest ways to categorize projects in an organization is to group them along the lines of two perspectives: significance of the project and project client. From the point of view of significance, a project can be strategic or operational, whereas from the perspective of the client it may be internal or external.

Using these parameters all projects in an organization may be classified into four groups, as shown in Figure 1.

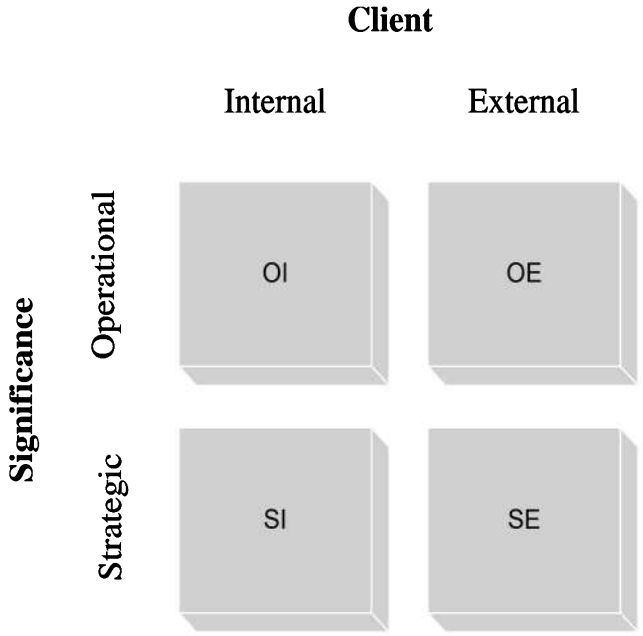


Figure 1: Categorization of projects relative to its significance and client

Project categorization system in organizations may be very complex. A research of literature conducted by Lynn Crawford, Brian Hobbs and Rodney Turner (Crawford et al. 2005) points towards a total of 37 distinctive characteristics that can be used for categorization of the projects. Table 1 shows the most commonly used ones, as well as the characteristics which were considered to be of greatest significance for categorization of projects.

Numerous types of projects are distinguished with respect to the industry in which they are implemented; their purpose; technical structure and other attributes. Each of the types of projects has its distinct attributes which help set them apart from others and define the style of management of their implementation.

Table 1: Comparison of most frequently used and most important attributes of project categorization (Crawford et al. 2005)

Most frequently used characteristics	Most important characteristics
Application area or product	Organizational benefit
Nature of work	Costs
Customer	Customer
Complexity	Application area or product
Costs	Complexity
Scope	Strategic importance
Strategic importance	Risk
Risk	Nature of work
Organizational benefit	Resources
Results	Scope

3. COMPETENCIES OF THE PROJECT MANAGER

The project manager is a person in charge of accomplishment of project objectives. He/she plans, organizes, leads and controls the work of the project team or the organizational unit in charge of project implementation. In smaller size projects, the project manager can also perform some of the project activities. The project team comprises people who are in charge of performing individual tasks or groups of tasks in line with the project manager's instructions. The members of the project team rely on one another and affect each other's work, and together, they work towards achieving the project goals (Jovanović et al. 2009).

To analyze and evaluate the competencies of the project managers, factors for evaluation of those competencies must be identified. It is believed that the successful project management requires a mix of skills, including interpersonal skills, technical competence, and behavioral skills along with the ability to understand the situation and people and to comply the appropriate leadership behavior (Strang, 2003). Research conducted on a series of seminars in project management by Barry Posner's (Meredith, Posner & Mantel, 1995) gave testimony that 1400 different skills are needed a project manager. 1400 of these positions are grouped in 6 field skills of project managers:

- Communication skills (listening, persuasion) - 84% of respondents believe that being a good communicator is the most important skills of project manager,
- Organizational skills (planning, goal setting, analysis) - 75%
- team building skills (empathy, motivation, a sense of loyalty and pride) - 72%
- Leadership skills (showing on the case, energy, vision, delegating, positive attitude) - 68%
- Ability to solve problems and tasks (flexibility, creativity, patience, perseverance) - 59%
- Technological skills (experience, knowledge of the project) - 46%.

El-Sabaa (2001) is, in his research, divided project manager's competencies into three categories:

1. The ability to work with people (mobilization, communication, problem solving situations, delegation of authority, political sensitivity, self-assessment, and enthusiasm);
2. Conceptual and organizational skills (planning, organizing, target orientation, the ability to see the project as a whole, ability to visualize the connection of the project with economic and non-economic subjects, problem orientation);
3. Technical skills (specific skills in the use of methods and techniques, project knowledge, understanding the methods, processes and procedures, technology requirements, the ability to use a computer).

A survey has shown that the relative importance of the ability to work with people estimated by project managers in the field of agriculture is 85.6%, while by the project manager in the field of electro-energy projects amounted to 84.4%, and project managers in the field of information systems 85.9%. The relative importance of conceptual and organizational skills is 77% (project managers in the field of agriculture), 82.9% (project managers in the field of electro-energy projects) and 78.9% (project managers in the field of information systems). Technical skills are, for all tested areas, received the least relative importance by project managers: agriculture - 48.4%, electrical energy - 50.5% and information systems - 52.5%.

The following text will provide a detailed overview of the competency factors based on ICP IPMA Competence Baseline, version 3.0 (IPMA, 2006). IPMA Competence Baseline is a common framework for assessment and certification of project managers promoted by the International Project Management Association – IPMA. IPMA Competence Baseline breaks down professional project management competencies in three broad ranges: technical competences, behavioral competences, and contextual competences. These ranges represent the integration of all elements of project management, together they describe a particular function and are independent for the most part. Each of the areas consists of competence elements which cover the key aspects necessary for successful project management.

The first range is that of technical competences consisting of competence elements that deal directly with the project management matter. In the 'Technical' range the competence elements described are needed to initiate and start, to manage the execution of, and to close and analyze a project. Depending on the kind, size and complexity of the endeavor being carried out, technical competences may apply to management of a project, program or portfolio.

In the technical range, the competence elements of a project manager include the so called "solid" elements of project management. The technical competences consist of the following twenty competence elements:

- **Project Management Success.** Achieving the project, program or portfolio objectives within the agreed constraints is a result of the competence of the project manager to integrate and balance among the requirements, activities and project results. This element also entails the capacity of project managers to analyze the effort underway, define the plan and procedures, implement the plan and bring the project to successful closure.
- **Interested Parties (Stakeholders).** This competence element refers to the capacity of the project manager to identify and analyze the interested parties, develop a strategy, define a plan and ensure that they are satisfied in each of the project phases.
- **Project Requirements and Objectives.** The project manager should be able to clearly identify project requirements, develop a business case, define objectives, validate requirements at key points in the project lifecycle and constantly assess compliance with the project objectives and implement the project in line with the previously defined requirements and agreed objectives.
- **Risks and Opportunities.** This element includes the competences of the project manager to identify risks and opportunities in the project, analyze possible consequences, develop a risk and opportunity response plan and regularly control and update the risk and opportunity response plan.
- **Quality.** The project manager is supposed to ensure that the project requirements are met in line with the main purpose for which the project is developed. This process entails development of the quality plan, quality assurance, and quality control.
- **Project organization.** Project organization covers the competence of the project manager to design appropriate organizational structure, identify the necessary resources and define the appropriate roles, levels of responsibility, procedures and means of communication.
- **Teamwork.** This competence element covers the competence of the project manager to build a team, develop a common sense of purpose, belonging and commitment and constantly improve the quality of work performed.
- **Problem Resolution.** This competence includes defining procedures for detecting problems, analyzing problems and identifying their root causes, capturing ideas to solve a problem and selection of possible solutions and implementation of the selected solution.
- **Project Structures.** A project manager should possess the appropriate knowledge to analyze and define different project structures by using methods such as WBS, PBS, OBS, etc.
- **Scope and Deliverables.** The purpose is to assess what needs to be done and what is covered by the project scope that has to be carried out for the project to finish successfully and produce the desired results.
- **Time and Project Phases.** This covers the project manager competences to implement the project within the approved schedule. It includes structuring, sequencing, estimating the duration and scheduling of the activities, including the monitoring and control of timely execution of the project activities.
- **Resources.** This is the capacity of a project manager to identify the necessary resources, develop a resource plan, optimize the use of resources, and monitor and control the use of resources.
- **Costs and Finance.** A project manager must have the capacity to adequately perform all activities related to planning, monitoring and control of the costs in the phases of project preparation and implementation.
- **Procurement and Contract.** This is the capacity of a project manager to obtain the best value for money of goods and services from project vendors and suppliers.
- **Changes.** A project manager should have the capacity to identify all proposed changes, analyze their consequences to the project, get the changes accepted or rejected, as well as to plan, execute and control the approved changes.
- **Control and Reports.** Includes the capacity to measure the actual progress and project performance, compare them with the plan, provide information to all project participants and stakeholders and undertake appropriate corrective actions.
- **Information and documentation.** This entails the capacity of a project manager to manage information and documentation by establishing appropriate information systems and defining documentation management procedures.

- **Communication.** A project manager should have the capacity to effectively manage project communications by developing communication plans, disseminating information and developing comprehensive reports.
- **Start-up.** Start up competence element entails the process steps such as initiating start up process, developing a detailed project management plan, securing resources and formal agreements to start the project.
- **Close-out.** Close-out refers to the competences to plan and carry out activities related to the completion of a project, handing over of the operational documents, agree on a process to resolve open issues, complete all financial transactions and update the final costs, conduct a comprehensive review of the project and record the lessons learned.

Behavioral competence range covers competence elements such as personal behavior and project management related behavior. This range also covers opinions and skills of the project manager. This is a set of different competency elements, which are relevant to the project manager, and project manager's competences in managing relations with the people in the project and the project stakeholders:

- **Leadership.** Leadership involves the capacity of a project manager to provide direction and motivate others in their role or task to fulfil the project objectives. Leadership is particularly important when a project encounters problems, where change is required or where there is uncertainty about the course of action.
- **Engagement and motivation.** Is the personal buy in from the project manager and from the people inside and associated with the project.
- **Self-control.** This is a systematic and disciplined approach of the project manager to coping with the daily work, changing requirements and stressful situations.
- **Assertiveness.** This is the ability of the project manager to his/her views clearly, persuasively and authoritatively.
- **Relaxation.** It Is the ability of a project manager to relax, recuperate and regroup after stressful events and react and make decisions in the light of the new circumstances.
- **Openness.** Openness is the ability of the project manager to make others feel they are welcome to express their suggestions, worries and concerns that the project can benefit from. Openness is an important competence and is a means to use knowledge and expertise of others.
- **Creativity.** Creativity is the capacity of the project manager to think and act in an original and innovative way. The project manager should exploit and encourage the creativity of individuals and the collective creativity of the project team, to obtain better results in the project.
- **Results Orientation.** This means the capacity of the project manager to focus the attention and attention of the project team on key objectives to obtain the optimum outcome for all the parties involved, so that the project results satisfy the interested parties.
- **Efficiency.** This is the ability of the project manager to use the time and resources in a cost effective manner in order to produce the agreed deliverables with as little investment as possible.
- **Consultation.** This is the competence of the project manager to reason, present solid arguments, to listen to other points of view, to negotiate and to find solutions.
- **Negotiations.** Negotiations are the means by which the project manager can resolve disagreements concerned with the project or programme to arrive at a mutually satisfactory solution. A well developed ability to negotiate can help the project manager to avoid real conflicts.
- **Conflict and crisis.** This competence element covers ways that the project manager handles conflicts and crises that can arise between different individuals and parties involved in a project or programme.
- **Reliability.** A reliable project manager builds trust with others by delivering on the promises made. Reliability covers responsibility, correct behaviour, robustness, and confidence.
- **Values appreciation.** This is the ability to perceive intrinsic qualities in other people and understand their point of view. It also covers the ability to communicate with them and be receptive to their opinions, value judgements, and ethical standards.
- **Ethics.** This competence element embraces the morally accepted conduct or behavior of the project manager.

Contextual competence elements describe the competence of the project manager to manage relations with the parent company and the competence to operate in a project focused organization. Contextual competences may be divided as project management in permanent organizations, and links between managing a project and managing a work of the organization. Contextual competence elements include elements that describe the concepts of projects, programs and portfolios and represent a connection between these concepts and the organization or between organizations, which are involved in the project. Understanding these concepts for project implementation is one of the most critical elements of the effective work of a project manager.

- **Project Orientation.** Project managers should have sufficient knowledge about managing project-oriented organizations.
- **Program Orientation.** This is the element of competence covers the competence of a project manager to develop and apply project management related knowledge.
- **Portfolio Orientation.** This is the capacity of the project manager to prioritize organization's projects and/or programs and optimize business improvement initiatives of the projects and programs to the organizational objectives.
- **Project, program and portfolio orientation.** This covers the processes of introduction and continuous improvement of the project, program and portfolio management in organizations.
- **Permanent Organization.** This competence element covers the relationship between the project organizations that are temporary and the permanent entities of the line managed organization contributing to or interfacing with the project work.
- **Business.** In order to be fully effective and efficient, project manager needs to fit into the business environment. Project, programme and portfolio management are linked to the organization's strategy.
- **Systems, products and technology.** This competence element covers the linkage between a project/programme and the organization regarding systems, products and/or technology.
- **Personnel Management.** This element covers aspects of project manager's competences related to projects and/or programmes including planning, recruitment, selection, training, retention, performance assessment, and motivation.
- **Health, security, safety and environment.** This element covers the activities of project manager that help ensure the organization, i.e. implementation project results, behaves appropriately in the context of health, security, safety and the environment.
- **Finance.** This element covers the financial context within which the organization operates. The project manager must provide information to the financial management of the organisation about the financial requirements of the project and co-operate in accessing the funds, checking payments and controlling the use of such funds.
- **Legal.** The project manager must operate within the legal boundaries and recognize the aspects of law applicable to the particular project or programme and which derive from the project or programme itself.

4. COMPETENCIES OF PROJECT MANAGER AND PROJECT TYPE

The project manager does not have to have specialized skills and knowledge for all tasks carried out in the project. The work of the project manager does not entail narrow specialization in a particular subject matter within the project scope. In order to efficiently perform the job, it is essential for the project manager to undergo appropriate training to acquire adequate knowledge and skills of project management and thus properly coordinate and direct the activities and stakeholders to achieve the desired project goals (Muller & Turner, 2010). The project manager must possess knowledge and understanding of economic and technical characteristics of the project activities to manage them adequately and make appropriate decisions (Oehmen, 2012).

The organizational structure of small size projects involving a small number of people is relatively simple. In these projects, the project manager can fairly easily and directly manage all individuals in the project. However, as the project expands so does the system of management, and the scope of control that one project manager may have over the activities is becoming restricted.

Technical expertise is one of the oldest skills that are required by the project manager. Most organizations today believes that a successful project manager requires a good knowledge of the area where the project is implemented (Levin, 2014). This attitude is related to the view that the project manager cannot be recognized

by the team if it is not a technical expert if it is unable to plan an elegant technical solutions, solve technical problems and identify possible technical problems regardless of the type of project (Muller & Turner, 2007).

It is certain that a particular expertise in the area where the project is implemented necessary for successful project management, but the question is what the level of knowledge necessary for the success of the project is. There is no universal answer to this question, but mostly depends on the type of the project and individual approach. Individuals who focus on the word "project" think that a perfect knowledge of the area where the project is implemented is critical, while on the other hand, individuals who emphasize the word "manager" believe in the expertise of its project team. The above mentioned research shows that knowledge of the area where the project is implemented is not a necessary factor for the successful conduct of the project, but some knowledge of the area in which it is implemented is necessary. Most of the problems in project implementation, which occur due to the project manager, are related to ineffective project management, but not for a lack of technical expertise.

Ability to work with the client / user can bind to the modern project manager for all types of projects. This ability has evolved from demands for basic communication and the need to see the project from the perspective of the client or user.

One of the most important characteristics of the modern project manager is the ability to plan the project into line with the impact of the project on business and adjust the implementation of the project so as to obtain relevant business results for the organization.

Ability to use appropriate methods and techniques of project management also falls into the classic skills of project managers. Today's project managers the ability to be more reflected in adapting the methodology of project management in accordance with different characteristics and type of the project. A successful project manager is also reflected in the ability to use methods and techniques of project management in order to recognize problems early enough and predicted solutions before problems have a significant impact on the results of the project.

The strategic ability of project managers is also a feature of the modern project manager (Levin, Ward, 2011). Due to the need for agility of organization, project manager no longer has the luxury of implementing the project out of close coordination with the strategic guidelines of the organization. The project manager must understand the strategy of the organization and customer/client and for each type of project has to review whether it is in accordance with the strategic goals of the organization. The project manager needs to fine-tune the project in accordance with changes in business strategy so that the project continues to be relevant to the organization or client. The project manager must be prepared for rapid changes in the priorities of the contracting authority of the project.

The ability to build a team and motivate the project team is now accepted as a necessary ability for all type of projects because technical knowledge of the project manager is not enough to motivate the project team members. Project managers usually borrow people from the functional units and therefore they need additional knowledge how to develop project team. The project manager should allocate tasks so as to keep the project team clearly focused on results and to encourage members of the project team so that they feel responsible for the achievement of project results.

Ability to solve problems has always been a desirable ability to project managers by the organization. This is often linked with the view that a project manager needs to be an expert in the area where the project is carried out. Today, however, the complexity of the project is much higher than before (and continues to grow) and the number of areas in the project for which the project manager needs to be an expert. Instead to expand the ability of problem solving, the contemporary project manager should have the ability to build the capacity of the team to effectively solve problems.

One of the capabilities of the modern project manager is possession of cultural intelligence. In a globally connected world, projects are no longer limited to one location nor are the users only at one location. Today, the resources and users are globally located, and the project manager should be able to accept the knowledge and skills as well as the specificities of cultures that individuals bring with them.

Capabilities that distinguish successful project managers at small projects are not also the skills that are essential in large projects. Desirable skills of project managers are changing in relation to the size of the team, as well as in relation to how the project includes various functional units or exceeds the boundaries of the organization, and whether the project is strategic or more operationally oriented.

The stronger expertise of project managers will lead small projects to success because personal knowledge and personal skills allow the project manager to successfully solve problems. But this approach has no meaning when the number of members of the project team is bigger. If the project takes place within a single functional entity conflicts and potential problems is much smaller. But if the scope of the project includes a larger and more functional units, then by the project manager requires different skills. If the project has to improve the existing functionality, then the focus is not on the ability of the strategic vision of the project managers. But if the project aims to achieve strategic results for the client's business, then the project manager should have the ability to see through the technical aspects of the project and to run the project according to the desired business results.

5. CONCLUSION

The paper presents the most important competencies of project manager in relation to the type of project. Organizations have to assess existing skills of project managers and check how they comply with the current requirements of the relevant organizations in the field of project management and trends in this area. Evaluation of project manager's competencies should allow defining directions of their further development.

When the number of projects increases in the organization (usually when the organization grows) the performance of project managers no longer depends only on his abilities and ways of implementation of the role, but also the willingness of the organization to adapt appropriate approach for projects execution. In this case it is necessary to reduce the so-called "feudal" relationship and hierarchy among organizational units and give project managers the authority to directly allocate resources and rewards individuals from the functional units. This is often a great change, but without it, there is little possibility that they will ever have a good track record on projects that include several functional units. Also, the introduction of the multiproject management principles into the organization will help project managers about assigning priorities and resource allocation.

Many things have influence that someone become a successful project manager. But project success comes from the ability of project managers to justify himself with the needs of each project. Project managers who are improving their skills in accordance with the requirements of modern project management can expect to be successful in the future regardless of the type of project.

REFERENCES

Crawford, L., Hobbs, J.B., Turner, J.R. (2005). Project Categorization Systems: Aligning Capability With Strategy for Better Results. Project Management Institute, Newtown Square.

El-Sabaa S. (2001). The skills and career path of an effective project manager, International Journal of Project Management, 19.

International Project Management Association (2006). ICB – IPMA Competence Baseline, Version 3.0.

Jovanović, P. (2015). Upravljanje projektom. Beograd: Visoka škola za projektni menadžment.

Levin G. (2014) Key Competencies for Success in Navigating Complexity. White paper. Project Management Institute, Inc.

Levin, G., & Ward, J.L. (2011). Program management complexity: A competency model. Boca Raton, FL: CRC Press.

Meredith R, Posner BZ, Mantel SJ Jr. (1995). Project management: a managerial approach. New York: John Wiley.

Muller R, Turner R. (2007) Matching the project manager's leadership style to project type. International Journal of Project Management 25. 21–32

Muller R, Turner R. (2010) Leadership competency profiles of successful project managers. International Journal of Project Management 28. 437–448

Oehmen, J. (Ed.) (2012). The guide to lean enablers for managing engineering programs. MIT-PMI-INCOSE. Massachusetts Institute of Technology, International Council for Systems Engineering & Project Management Institute.

Strang, K.D. (2003). Achieving organizational learning across projects. In: Paper presented at the PMI North America global congress 2003, Baltimore, USA.

KNOWLEDGE SHARING IN PROJECT ENVIRONMENT

Marija Todorović*[1], Danijela Toljaga-Nikolić[1], Zorica Mitrović[1]
[1]Faculty of organizational sciences, University of Belgrade
*Corresponding author, e-mail: todorovicm@fon.bg.ac.rs

Abstract: *This paper presents discuss the topic of knowledge sharing in project environment.There is an awareness of the fact that knowledge sharing between projects increases organizational knowledge and add value to future project and the performing organization. On the other hand, literature and a number of researces showed that there are different mechanisms that can be used to share knowledge, depending of project characteristics. This papers analysis literature on knowledge sharing in project environment, relying on knowledge acquisition and creation of new knowledge. Paper also present the results of empirical research conducted in Serbia to reveal what are the most frequently used mechanisams to share knowledge between project – formal or informal.*

Keywords*: project, knowledge, project environment*

1. INTRODUCTION

Knowledge sharing between projects increases organizational knowledge. Each project has different plans, results, problems and the level of performances which gives plenty of opportunities for learning. By integrating and sharing of such experiences between projects a company can create the significant base of organizational knowledge for future endeavors. The existence and development of the knowledge base in the organization has a significant effect on the strategic development of an organization (Szulanski, 1996; Nagarajan & Mitchell, 1998).

Cooper et al. (2002) present a dynamic process of learning between projects, which can be used by managers to test ideas, see impacts and capture best practices. The conclusion is that the procedures for the acquisition of knowledge and dissemination of lessons learned should be organized. However, learning within the project does not happen naturally, it is a complex process which needs to be managed (Todorovic et al., 2015). The learning process can not exist in isolation from other processes, and organizational learning is impossible unless it is seen as a supplement to other processes. Sense (2007) highlights the following five factors that influence the creation of a learning environment: cognitive style, the relationship between the participants in the learning process, the hierarchical scale, knowledge management and situational context. Arthur, DeFillippi i Jones (2001) also emphasize the foundation of the project success on learning, classifying the success of the project in terms of performances and aspects of learning. Knowledge generated by learning from the projects could lead to far-reaching changes in the strategic focus of the organization (Brady & Davies, 2004). One of the most recent papers in the field of knowledge management between projects confirms the hypothesis that an appropriate environment, including social and technological aspects, enable knowledge management process and has a significantly positive impact on documenting of project knowledge (Reich et al., 2012).

2. KNOWLEDGE ACQUISITION IN PROJECT ENVIRONMENT

The ways of acquiring of organizational knowledge include: the usage of knowledge that already exists in the organization or gathering knowledge that exists outside the organization, instructions or direct transmission of knowledge from the people who own it, observation and notification of problem solving, brainstorming, protocol analysis e.g. experts are required to express their thoughts in solving problems aloud, nominal group technique, Delphi technique, etc. To acquire knowledge in project environment following steps need to be implemented: use of certain assets in order to collect information from people involved in the project; interpretation of information and draw conclusions based on the of experts knowledge and their judgment; the usage of those interpretations to form policies that represent the thinking of people who have experience of working on projects.

3. KNOWLEDGE SHARING IN PROJECT ENVIRONMENT

Acquired knowledge becomes information and the process of sharing knowledge should enable not just a simple transfer of such information but transfer of knowledge to new users in their context and then move into knowledge. The process, which involves the adoption of new information and linking them with existing

knowledge and experience, is a learning process. Learning and knowledge are separate but related processes in terms of learning to create knowledge, and expertise to influence the future of learning (Lyles & Easterby-Smith, 2003).

The process of knowledge sharing is in the literature often treated as a black box (Berends, 2005). The knowledge gained is not always completely and without any changes useful to the project. It can be either to extensive or too specific. In other words, it is necessary to adapt the requirements of a particular project. The process that enables this is the process of *knowledge creation*, based on existing knowledge gathered within and outside the organization, adapting it to the needs of the project.

The knowledge sharing can be seen as a process of reconstruction of knowledge, not as a simple act of sending and receiving of organizational knowledge (Abou-Zeid, 2005). In other words, when we talk about the knowledge transfer, but without the creation of new knowledge without an existing organization, then we can talk just about information transfer (Boder, 2006).

Knowledge creation can be accessed through a variety of ways such as training, hiring external resources, recruiting people of different profiles in order to create fresh knowledge base. This is a question of innovation - effectively turning ideas into action. The challenge is not to lose creative ideas and allow them to flow wherever they can be used. Most often the difference between the old and new knowledge is not always clear. Innovation can often be drawn from the lessons of the past. The application of old knowledge almost always involves some adaptation and in the process creates new knowledge. In the end, the quality of knowledge does not depend on the fact whether it is old or new, but whether it is relevant. The following text of this paper is focused more on the process of knowledge creation, the process of integration of project knowledge.

4. KNOWLEDGE INTEGRATION IN PROJECT ENVIRONMENT

Integrating knowledge present the set of activities of team members that share individual knowledge and combine them to create new knowledge (Okhuysen & Eisenhardt, 2002). The core activities of any project-oriented organization is a coordination which is achieved through the active participation of individual specialists and managers. Such coordination can not be achieved without access to an adequate knowledge.

In many project there are multifunctional teams reither than functional teams. Multifunctional teams are formed under the assumption that they will combine specialized knowledge in different organizational units. However the way in which knowledge will be integrated remains often poorly explained. Multifunctional teams are typical for the following three situations: when the focus is on creativity and innovation, when you need to reach a consensus through community input, negotiation, or investigation and when it is necessary to manage strategic change.

The integration of knowledge collected from various projects has its economic value, because the organizational competitiveness is affected by diversity and strategic value of specialized knowledge and also the organization's ability to integrate knowledge effectively. An organization's ability to integrate knowledge depends on the mode of communication and working procedures (routines) and the way in which implicit knowledge into explicit codified rules. On the efficiency of the process of integration of knowledge affects the existence and developed knowledge among the participants, coordination and organizational structure (Papke-Sields, Beise, & Quan, 2010).

Despite the existence of knowledge that should be integrated, one of the necessary preconditions is the common basis between users of this knowledge. E.g. in the case of sharing knowledge for the development of a new trade system between technicians and sales managers, the key point is that sales have basic knowledge about the technology to be applied, a technician basic knowledge about the process of trade. Coordination is a process that must be constantly improved. In addition, the very organizational structure affects efficiency and effectiveness through the integration of knowledge way to connect the activities and tasks that are running.

The greater scope of knowledge that should be integrated, the lower is the efficiency of knowledge integration. The greater the volume of knowledge requires better coordination, and organizations that do not have a lot of experience in this process becoming less efficient in this process. On the other hand, a larger scope of knowledge strengthens the competitiveness of organizations and reduces the chance for copying from other organization. Flexibility of the process of integration of knowledge depends on the organization's ability to reconfigure existing knowledge by promoting innovation (Love et al., 2005).

The above theoretical assumptions are tested on four projects: the introduction of ERP systems, the development of new banking services, business process redesign, introduction of management systems they know (Love et al., 2005) The first conclusion is that the formation of common knowledge in multifunctional teams depends on the perception the value of the project by the stakeholders (of their support); the second thing is the previous experience of the organization in the implementation of complex projects.

Further, knowledge sharing is associated with the existence of objective measures, that explain the purpose of the project results. The way of communication among team members, sharing "narrative story," was significantly conditioned by the organizational structure in all four projects. However, it was noted that the exchange of knowledge in an informal way the project is affected by culture, or accepted the values and principles of conduct by members of the team. In this part of the practice is different from theory. According to this study, the level of efficiency in the context of multifunctional projects depends precisely on the communication process, how to manage social capital and how organizational structure contributes to the development of social capital.

Prencipe (2001) based on the collection of data through interviews and questionnaires with projects from six organizations developed a schematic view of learning as an attempt to create a pattern for learning process between projects. First, the organization is divided into three kategoije: social projects where prevailing social processes and work with people; technical projects with clearly articulated processes and ICT projects. For each of the three project's categories the author developed a matrix that shows the mechanism for the accumulation of experience, knowledge articulation and codification of knowledge.

Table 1. Social projects

	Learning process		
Level of the analysis	*Acumulation of experience*	*Knowledge articulation*	*Knowledge codification*
Individual level	• On-the-job training • Job rotation • Specialization	• Figurative thinking • Thinking aloud • Notes	• Diary • Reporting system • Individual system design
Project level	• Reuse of experts • Developed group thinking • Face-to-face communication • Informal encounters • Imitation	• Brainstorming • Formal project reviews • Debriefing meetengs • Ad hoc meetings • Lessons/learned/post-mortem meetings • Intraproject correspondence	• Project plan • Milestones • Meeting minutes • Project history files • Intraproject lessons learned database
Organizational level	• Informal organizational rutines, rules and selection processes • Departmentalization and specialization • Communities of practice	• Project manager camps • Knowledge rereats • Professional network • Knowledge facilitators and managers • Interprojet correspondence • Interproject meeting	• Drawings • Process maps • Project management process • Lessons learned data base

Table 1 present "L" form, that has a social approach. The emphasis is on creating and sharing tacit knowledge, based on experience through joint work on the project. Contacts face to face and via social media have great significance. Learning between projects has more informal character and involves sedimentation of new practices in the form of routine.

Table 2. Techical projects

Level of the analysis	*Learning process*		
	Acumulation of experience	*Knowledge articulation*	*Knowledge codification*
Individual level	• On-the-job training • Job rotation • Specialization	• Figurative thinking • Thinking aloud • Notes	• Diary • Reporting system • Individual system design
Project level	• Reuse of experts • Developed group thinking • Face-to-face communication • Informal encounters • Imitation	• Brainstorming • Formal project reviews • Debriefing meetengs • Ad hoc meetings • Lessons/learned/post-mortem meetings • Intraproject correspondence	• Project plan • Milestones • Meeting minutes • Project history files • Intraproject lessons learned database
Organizational level	• Informal organizational rutines, rules and selection processes • Departmentalization and specialization • Communities of practice	• Project manager camps • Knowledge rereats • Professional network • Knowledge facilitators and managers • Interprojet correspondence • Interproject meeting	• Drawings • Process maps • Project management process • Lessons learned data base

Table 2 present "T" shape that has a technical approach and is characteristic of the organization attach importance to the articulation process at all levels. Meetings are often organized in order to improve communication and knowledge transfer.

Form "steps" (shown in Table 3) refers to organizations with developed advanced ICT tools to support learning between projects. Their efforts are focused on the codification and storage of knowledge developed during the execution of the project and its documentation in order to be used on other projects. These processes are aimed at creating and renewing formal procedures.

This approach is presented by Prencipe (2001) and have been modified by Love et al (2005) who state that is arguably how an extremely dynamic process of learning between projects can be presented by static matrix. In addition, looking at the phases and types of projects can be concluded that in relation to them a learning mechanism can be more acceptable than another.

For example. face to face communication and meetings are appropriate for the activities of problem solving and creative activities that are present usually at the beginning and end of the project, while the processes based mechanisms are more appropriate in the phases of the project in which the plans are already in place.

However, the above scheme represents a good starting point for presenting similarities in learning styles between projects in different organizations.

Table 3. ICT projects

Level of the analysis	*Learning process*		
	Acumulation of experience	*Knowledge articulation*	*Knowledge codification*
Individual level	• On-the-job training • Job rotation • Specialization	• Figurative thinking • Thinking aloud • Notes	• Diary • Reporting system • Individual system design
Project level	• Reuse of experts • Developed group thinking • Face-to-face communication • Informal encounters • Imitation	• Brainstorming • Formal project reviews • Debriefing meetings • Ad hoc meetings • Lessons/learned/post-mortem meetings • Intraproject correspondence	• Project plan • Milestones • Meeting minutes • Project history files • Intraproject lessons learned database
Organizational level	• Informal organizational rutines, rules and selection processes • Departmentalization and specialization • Communities of practice	• Project manager camps • Knowledge rereats • Professional network • Knowledge facilitators and managers • Interprojet correspondence • Interproject meeting	• Drawings • Process maps • Project management process • Lessons learned data base

5. KNOWLEDGE SHARING IN PROJECT ENVIRONMENT IN SERBIA

In order to investigate what are the most frequently used mechanisms for knowledge sharing, a reserch was conducted. The questions were design to find out do the respondents use more formal (documented) or informal ways to acquire and share knowledge in project environment. More than 100 questionnaires were collected from participants on project from different industries (construction, processing industry, metal industry, wood industry, trade, public sector, healthcare, architecture, design, etc.)

Research results show that 72% of respondents answerd that they have some documented procedure for project management in their organizations. On question what area of project management are regulated the most, the results show that project planing, monitoring, control and reporting are regulated in a very high level, hence project initiation and selection are in the most of partially or even not regulated.

Since the purpose of this research was to discover wherther team members use a systematic approach to acquire and share knowledge between project the question were oriented on how they treat the problems, risk and changes on their project/is there any documented file on those issuess; do they always create a final report on competed project or this action is not a common practice; and what are the most frequently used mechanism for knowledge sharing: project files/reports or less formal communication.

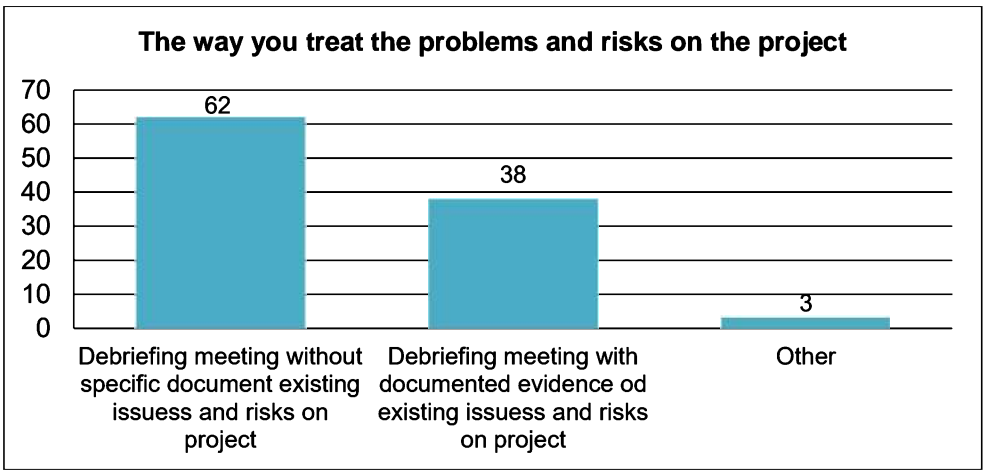


Figure 1. The way you treat the problems and risks on the project

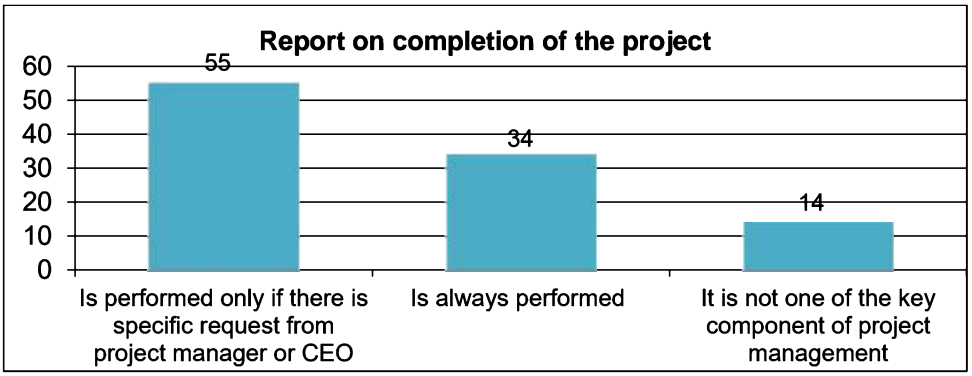


Figure 2. Report on compleation of the project

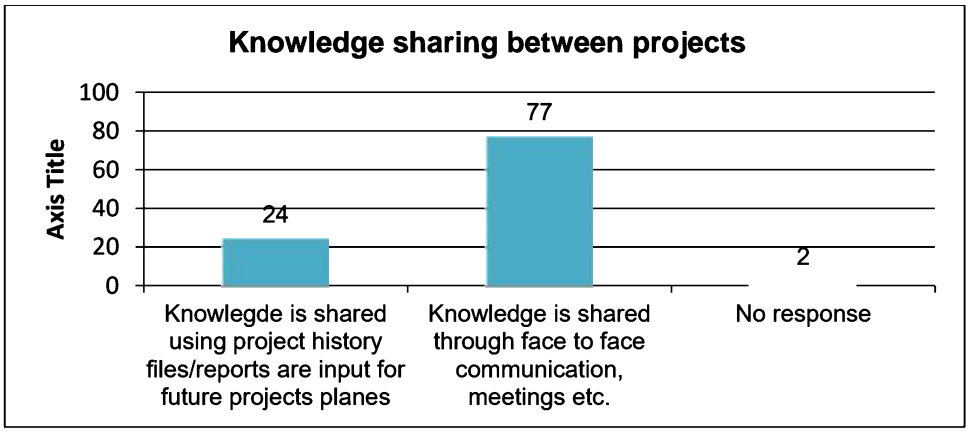


Figure 3. Knowledge sharing between projects

Results showed that respondants use mostly unformal mechsnisms to share knowledge between projects. Around 60% of respondants answer that discuss project risks and problems but that they don't have a procedure to document those issues. Only 38% answered that they document all project problems and risks. Final report on compliteted project is always performed in only 34%, in more than 50% final report is performed only if CEO or project manager request it.

From the perception of the respondants knowledge between project is shared mostly using informal communication, meetings, experts reusage. Only 24% of them said that they use files/reports from preveuos projects to acquire information and knowledge.

6. CONCLUSION

Through literature review it can be concluded that the key factors of influence on knowledge sharing process in project environment are: organizational culture, organizactional structure, stakeholder support, and the level of coordination of this process along with other procesess in project. Literature points on significance of

knowledge sharing between projects for organizational knowledge. Literature also shows that there are different mechanisms to acquire, articulate and codify knowledge beetwen projects in accordance to project characteristics. However, in the practice there is an evidence of knowledge sharing using mostly informal ways instead of formal processes. It is not doubtfull that knowledge can and should be shared using informal ways and that benefits of tacit knowledge can be achieved, but the question is how much informations and knowledge are passed if there is no formal evidence of project realization (problems, risks, changes and other issues, compliation etc.) and the usage of project history files for future projects.

REFERENCES

Abou-Zeid, E. (2005). A culturally aware model of inter-organizational knowledge transfer. Knowledge Management Research & Practice, 3 (3), 146-155.

Arthur, M. B., DeFillippi, R. J., & Jones, C. (2001). Project-based learning as the interplay of career and company non-financial capital. *Management Learning, 32*, 99-117.

Berends, H. (2005). Exploring knowledge sharing: moves, problem solving and justification. *Knowledge Management Research & Practice , 3* (2), 97-105.

Boder, A. (2006). Collective intelligence: a keystone in knowledge management. *Journal of Knowledge Management, 10* (1), 81-93.

Brady, T., & Davies, A. (2004). Building project capabilities: From exploratory to exploitative. *learning, 25*, 1601-1622.

Brooks, N., Morton, S., Dainty, A., & Burns, N. (2006). Social processes, patterns and practices and project knowledge management: A theoretical framework and an empirical investigation. *International Journal of Project Management , 24*, 474-482.

Cook, S., & Brown, J. (1999). Bridging epistemologies: the generative dance between organizational knowledge and organizational knowing. *Organization Science , 10* (4), 381-400.

Cooper, K. G., Lyneis, J. M., & Bryant, B. J. (2002). Learning to learn, from past to future. *International Journal of Project Management , 20*, 213-219.

Davenport, T., De Long, D., & Beers, M. (1998). Successful Knowledge Management Projects. *Sloan Management Review*, 43-57.

Desouza, C., & Evaristo, R. (2006). Project mAnagement office: A case of knowledge-based archetypes. *International Journal of Information Management , 26*, 414-423.

Grant, R. (1996). Toward a knowledge-based theory of the firm. *Strategic Management Journal , 17*, 109-122.

Lindquist, L., Soderlund, J., & Frohm, C. (2002). *Knowledge Management in Technology and Project Based Firms.* East Horsley, UK: EuroProjex Ltd.

Love, E., Fong, S., & Irani, Z. (2005). *Management od Knowledge in Project Environment.* Burlington: Elsevier Ltd.

Lyles, M., & Easterby-Smith, M. (2003). *The Blackwell Handbook of Organizational Learning and Knowledge Management.* Oxford: Blackwell Publishing.

McDermott, R., & O'Dell, C. (2001). Overcoming cultural barrieres to sharing knowledge. *Journal of Knowledge Management , 5* (1), 76-85.

Okhuysen, G., & Eisenhardt, K. (2002). Integrating knowledge in groups: how formal interventions enable flexibility. *Organization Science, 13* (4), 370-386.

Papke-Sields, E., Beise, C., & Quan, J. (2010). Do project managers practice what they preach, and does it matter to project success? *International Journal Project Management, 28*, 650-662.

Petrović, D. (2012). Analiza procesa sticanja i trensfera projektnog znanja. *XVI Internacionalni simpozijum iz projektnog menadžmenta "U susret ekonomiji znjanja - upravljanje projektima znanja"*, 24-31. Zlatibor: YUPMA.

Prencipe, A. T. (2001). Inter-project learning: processes and outcomes of knowledge codification in project-based firms. *Research Policy, 30*, 1373-1394.

Reich, H. G., & Sauer, C. (2012). Knowledge management and project-based knowledge in it projects: A model and preliminary empirical results. *International Journal of Project Management , 30*, 663-674.

Sense, A. (2003b). A model of the politics of project leader learning. *International Journal of Project Management, 21*, 107-114.

Sense, A. (2007). Structuring the project environment for learning. *International Journal of Project Management, 25*, 405-412.

Shapiro, G. (1999). *Inter-Project Knowledge Capture and Transfer: An Overview of Definitions, Tools and Practices.* Complex Product System Innovation Center.

Swap, W., Leonard, D., Shields, M., & Abrams, L. (2001). Using mentoring and storytelling to transfer knowledge in the workplace. *Journal of Management Information Systems, 18* (1), 95-114.

Todorović, M. L., Petrović, D. Č., Mihić, M. M., Obradović, V. L., & Bushuyev, S. D. (2015). Project success analysis framework: A knowledge-based approach in project management. *International Journal of Project Management*,*33*(4), 772-783.

MATURITY MODEL COMPARATIVE ANALYSIS: OPM3 VS. IPMA DELTA MODEL

Dragan Bjelica*, Zorica Mitrović, Marija Todorović
Faculty of Organizational Sciences, University of Belgrade
*Corresponding author, e-mail: bjelicad@fon.bg.ac.rs

Abstract: *The purpose of the paper is reflected in the comparative analysis of the maturity models, specifically in relevant aspects of the IPMA Delta and OPM3 maturity model. The comparative analysis includes general and specific observation' characteristics from individual, project and organizational point of view. General characteristics include maturity model levels, maturity development, maturity assessment. Specific characteristics of each model are the essence of the model as well as what they clearly emphasize in maturity development – procedures, best practices, assessors' approach, etc. A maturity model assumed that progress according to goal and expected results' achievement comes in stages. Therefore, this analysis identifies potential issues for maturity implementation: "how to fulfill certain requirements", "how to quantify qualitative aspects of evaluation" and maturity model perceived as a "promotional tool". Theoretical and practical implications are discussed.*

Keywords*: maturity, assessment, project management, model, IPMA Delta, OPM3*

1. INTRODUCTION

In psychology, maturity has been perceived as a willingness to respond appropriately to external influences. This reaction is generally less instinctive. "Being mature" means to know how to behave in a given place and at the appropriate time in accordance with a specific circumstances and culture. Human being development theories include the purpose of life concept, which highlights the maturity of a clear purpose in life, direction and intention, which contributes that life has meaning. Maturity has different definitions across the legal, social, religious, political, emotional and intellectual context. According to the mentioned aspects, the concept and definition of maturity and immaturity, usually is explained very subjective.

Generally speaking, there are two main reasons for maturity models implementation in organizations. The first reason is reflected that suggested maturity model will help in verification process – comparing results with best practices in industry and categorization according to maturity level. The second reason for the maturity model implementation is an assessment of its current capabilities and goals to achieve the desired level. Organization gets an insight into their strengths and weaknesses and clearly observed actions and areas in which improvements are needed. In addition to the above, maturity model implementation also raises awareness in the context of possible improvements within the organization.

2. PROJECT MANAGEMENT MATURITY DEVELOPMENT

Maturity model development begins with the development of the first maturity model, known as maturity model based on the capabilities (Capability Maturity Model), created by the Institute for Software Engineering (Software Engineering Institute, SEI), with the support of the Ministry of Defense - United States. The model was developed and upgraded in the period from 1986 to 1997, and got his real successor in 2002, a model that is now known as Integrated model-based capabilities, (The Capability Maturity Model Integration, CMMI). Although primarily intended for the software industry has found its application in other business areas and serve as a basis for making the most famous models today.

Since the current stream of maturity analysis dedicated to the assessment of project management maturity is still in its early phases, there are many important aspects that remain unclear and, should be addressed by future research. Articles within scientific area maturity model development have the main objective of developing or creating a new maturity model. This may contain conceptual as well as design oriented models or descriptions of models, if the purpose is the introduction of a new model. Scientific articles within scientific area maturity model application aim principally at the maturity models' implementation in several

aspects or specific domains. They also include maturity appraisal and model implementation. Articles within scientific area maturity model validation have the main purpose of validating existing maturity models. This includes empirical as well as conceptual validation, maturity models comparisons, simulations, best practices, case studies, and so on. The main objective of articles within this topic area meta-articles is maturity models characteristics. These are, for instance, literature reviews, process models for the development of maturity models, or other theoretical perspectives (Wendler, 2012).

One important topic would be to assess and compare project management maturity in different strategic aspects for organization. Evaluation of maturity in project management company depends on the person carrying out the assessment and its ability to obtain important information about project management, as well as intelligent evaluation of data in order to show meaningful conclusions. In most situations, the auditors were hired consultants which are not connected with the organization, hired for their experience and expertise. This contributes to the impartiality and objectivity in the evaluation. Future research could analyze and compare project management maturity between organizations that largely rely upon internal projects, and organizations that generally contract for external project support. Future research could also analyze project management maturity in terms of the strategic importance of project management phases and activities. One of the most important aspects that future research should address is to emphasize a clear relationship between project management maturity and successful project delivery. The value of project management maturity assessments clearly establish this vital link (Grant & Pennypacker, 2006). The implementation of an adequate project success analysis can contribute to knowledge management in project environment (Todorović, Petrović, Mihić, Obradović, & Bushuyev, 2015).

Table 1: Overview of the maturity model

Model	**Organization**
Capability Maturity Model Integration – CMMI model	Carnegie Mellon University
Information Technology Capability Maturity Framework – IT CMF model	Innovation Value Institute
Portfolio, Programme and Project Management Maturity Model – P3M3 model	OGC i Axelos
IPMA Delta model	International Project Management Association - IPMA
Organizational Project Management Maturity Model – OPM3 model	Project Management Institute - PMI
COBIT Maturity Model	IT Governance Institute - ITGI
Project Maturity Model – PM^2 model	Interthink
PRINCE 2 Maturity Model - P2MM model	APMG International
Gartner Maturity Model for Project and Portfolio management	Gartner
Project Management Maturity Model – PMMM model	PM Solutions

3. PERFORMANCE EVALUATION AND MATURITY LEVELS

Performance evaluation and analysis of organizational maturity has become popular in the last decade, where the area of IT projects stand out as the primary area for the maturity model implementation. The concept of maturity for most people is associated with complete development. The same principle is applied in the project management context. There are different definitions in project management scientific field for project maturity. Different maturity concept analysis showed that the repeated project success and organizational strategic objectives are commonly associated with maturity in project management, and is generally perceived as:

- implementation of project management methodology and related processes, that they repeat with higher probability of success (Kerzner, 2001)

- the organization's ability to repeat the success in the successors' projects (Dooley, Subra, & Anderson, 2001)
- the overall ability of the organization to select and manage projects in a way that they support the organizational strategic objectives (Hermarij, 2013)

The basic concept of maturity models characterize the levels and the path of maturity. Each phase has a corresponding features, which include business improvements.

Table1: Maturity levels - characteristics

	Processes	Documentation	Management	Metrics
Level 1	There is no established practices and standards	There is no collected documentation – ad hoc approach	Management understands and is aware of the project management approach.	Collected informally on an ad hoc basis
Level 2	Processes exist, but there are not considered as organizational standards	Documentation exists only for the basic processes	Management supports the project management approach, but understanding and involvement is not consistently applied to all projects. Large projects are implemented in a systematic manner, and management is involved in such projects.	There are basic metrics to track costs, time, and technical specifications.
Level 3	All the project management processes are established as organizational standards. These processes include customers as part of the project team. Almost all projects using these standards.	Documentation exists for all projects.	Management is involved in key decisions related to the inputs and approvals.	Metrics formally collected and each project is evaluated and managed in the context of other projects.
Level 4	Processes, standards and systems support project management approach.	The processes are documented and support metrics' usage in the decision making process.	Management understands its role in the project management processes. There are different management styles and different project management requirements for various projects.	Effectiveness and efficiency are used as metrics. All projects, changes and issues are evaluated against the metrics of cost estimates, the planned assessment and calculation methods according to earned value.
Level 5	The established processes are actively used to improve project management activities.	Lessons learned are constantly reviewed and used to improve the standard processes and documentation in project management.	Management is focused on continuous improvement.	Metrics collected during the project implementation are used to analyze the project performance and to improve organizational decision-making process in the future.

The purpose of the maturity model implementation refers to the following aspects:

- Descriptive: Capability Maturity Model was created to describe the process whereby the current competencies of the organization evaluated according to preset criteria and therefore be used as a diagnostic tool. After organizational maturity assessment, it is necessary to inform internal and external stakeholders.
- Providing guidelines: Maturity models provide guidelines for performance improvements.
- Comparative aspects: Maturity paths are used for comparative purposes in order to provide benchmarking for internal and external stakeholders. The organization is compared with the prior therein based on historical data, then compared with industry norms and averages from the industry, competitors and set objectives in achieving the appropriate level of maturity.

4. IPMA DELTA MODEL

IPMA Delta model integrates the latest aspects of knowledge management and project management competences called "360^0 assessment of competencies". It was created by the International Project Management Association - IPMA. IPMA Delta model basically defines three aspects of observation and based on them integrate evaluation system: Individual level estimates (based on the IPMA Competence Baseline 3.0 - ICB), project level assessment (based on the IPMA Project Excellence Model) and organizational level estimates (based on IPMA Competence Baseline Organisational - OCB).

Certification system in organization provides confirmation that the organization has implemented a system with all relevant aspects and in accordance with company policy. Organizations based on an assessment of their position and status, can establish and ipmrove systems for project management. Top management decide about the organizational strategic directions and needs for improvement and therefore set goals for maturity improvements.

4.1. Individual level assessment

Individual certification level is based on an estimate of technical, behavioral and contextual competencies in project management. Each level of certification (A to D) carries the appropriate knowledge, skills and experience required. This system can be described as a "career focused on certification." Within three areas of competence there are 54 elements of competences (International Project Management Association, 2006).

4.2. Project level assessment

IPMA Project Excellence model (IPMA Project Excellence Model - PE) is modified for the purposes of self-evaluation for organizational projects and programs. It is based on the EFQM model (European Foundation of Quality Management) and principles of total quality management. IPMA Project Excellence model has been applied in many national and international associations for the reward system within the IPMA networks. This benchmarking tool has been used to measure project excellence. This model consists of segments that concern employees, resources, processes, leadership, project goals (Backlund, Chronéer, & Sundqvist, 2014).

4.3. Organizational level assessment

IPMA Organizational Competence Baseline defines organizational competence in project management, program and portfolio management. This standard defines organizational competences as the ability to integrate the people, resources, processes, structure and culture in projects, programs, and portfolio system. Organizational competence in project management should be specifically aligned with the mission, vision, organizational strategy, and should be focused in order to achieve results to ensure continuous organizational development. (International Project Management Association, 2013).

4.4. Delta effect

IPMA Delta model provides information based on the Delta, where the effect of competence ipmrovements show the maturity path to a higher class. Based on the analysis of individual, project and organizational competencies, the organization has insight into the strengths and weaknesses of competences for project management. The organization independently determines which category of competencies wants to certify. Also, the IPMA Delta shows the "delta effect" between existing and desired competencies in project management (International Project Management Association, 2014).

5. OPM3 MODEL

Model OPM3 (Organizational Project Management Maturity Model) is one of the most recognized standards in the world for assessing organizational maturity published by the Project Management Institute (PMI). The model was designed in 1998. He was preceded by the release PMI - Special Report of ethics, standards and accreditation, published in 1983, followed by PMBOK standards published in 1987 and the PMBOK Guide in 1996 and framework for development of project manager competencies OPM3 in 2002 (designed to translate the strategy into successful results - consistent and predictable).

Organizational Project Management presents systematic management of projects, programs and portfolios that are consistent with the strategic objectives of the organization. The concept of organizational project management is based on the idea that there is a correlation between the ability in the management of projects, programs and portfolios and its effectiveness in strategy implementing. The degree to which the organization implemented this system for project management called organizational maturity in project management.
OPM 3 was initially designed without an overall system related to the maturity levels. Establishing the specific maturity level would mean that the maturity analysis is one-dimensional. From the other hand, OPM3 is multidimensional. OPM3 also categorizes capabilities within the five process groups of project management (initiation, planning, implementation, control and closing) providing the possibility of evaluation through the four levels of maturity (Project Management Institute, 2003).

OPM3 standard has three key elements:

1. Knowledge - describes the organizational project management and organizational maturity in project management, explaining why they need it and how maturity in project management can be identified in the organization. PMBOK 5 is a key connection with maturity assessment.
2. Assessment - presents the methods, processes and procedures that an organization can use to realize self-assessment. Evaluation is done using the interactive tools of best practice that suggests further detailed consideration competencies required for project/program/portfolio implementation.
3. Improvement - provides processes, the skills' list they need to improve from lowest maturity level to higher levels of maturity.

6. COMPARATIVE ANALYSIS BETWEEN MODELS

Maturity models can be used as a short-term tool for assessing the maturity of enterprise, program or portfolio organization (currently determining the maturity) or as a long term asset for constantly improving the business processes of the organization or projects, programs and portfolios (continuous development process). One of the general characteristics, immanent to considered models, is that the assessment is determined on the basis of questionnaires and / or interviews. Usually it is pre-defined set of questions. The negative aspects for IPMA Delta and OPM3 model implementation are:

- Models describe "what it takes to be fulfilled in order to reach a certain level", but do not say anything about "how to fulfill certain requirements"
- There are not sufficient quantitative indicators for all aspect of maturity assessment
- The maturity assessment has been perceived as a "promotional tool"

Following table (Table 3.) characterize IPMA Delta model and OPM 3 model constraints and main components:

Table 3. Comparison between IPMA Delta model and OPM3 model constraints and components

Model	Constraints	Components
IPMA Delta	• Limitations on the quantification of maturity • Qualitative assessments of project and organizational components • Subjectivity of assessors (gives appropriate level of organizational maturity)	• Individual competence analysis (based on the IPMA Competence Baseline) • Project analysis of competences (based on EFQ model) • Organizational analysis of competences (based on IPMA Competence Baseline Organizational)
OPM3	• The framework should be accepted by top management • Highlighting the time, cost and less value being delivered • Insufficient emphasis on complexity, continuous learning, social processes, creating value, broad conceptualization	• Knowledge (organizational project management maturity and best practices based on the PMBOK processes • Evaluation (methods for the evaluation of best practices) • Improving (the order to develop the ability aggregating them into best practices)

7. CONCLUSION

Research shows that organizations have increased the level of maturity in project management with cost savings, increased ability to predict a time and schedule for the project and increase the level of quality. This implies that increasing maturity in project management positively affects the performance improvement in project. IPMA Delta defines five classes of organizational competencies in project management, emphasizing the current state of the organization with the areas where improvements are needed. Also, IPMA Delta Model is based on competences, while the OPM3 is based on knowledge and best practices. IPMA Delta and OPM3 model show the evolutionary trends in the project evaluation and appraisal, and create excellence aspects in project management field.

This paper is a result of the Project No. 179081 funded by Ministry of Education and Science of the Republic of Serbia: Researching Contemporary Tendencies of Strategic Management Using Specialized Management Disciplines in Function of Competitiveness of Serbian Economy.

REFERENCES

Backlund, F., Chronéer, D., & Sundqvist, E. (2014). Project Management Maturity Models – A Critical Review. *Procedia - Social and Behavioral Sciences*, *119*, 837–846. doi:10.1016/j.sbspro.2014.03.094

Dooley, K., Subra, A., & Anderson, J. (2001). Maturity and its impact on new product development project performance. *Research in Engineering Design*, *13*(1), 23–29. doi:10.1007/s001630100003

Grant, K. P., & Pennypacker, J. S. (2006). Project management maturity: an assessment of project management capabilities among and between selected industries. *IEEE Transactions on Engineering Management*, *53*(1), 59–68.

doi:10.1109/TEM.2005.861802
Hermarij, J. (2013). *Better Practices of Project Management Based on IPMA Competences* (3rd editio.). Van Haren Publishing.
International Project Management Association. (2006). ICB - IPMA Competence Baseline. International Project Management Association.
International Project Management Association. (2013). IPMA OCB - IPMA Organisational Competence Baseline - The standard for moving organisations forward. International Project Management Association.
International Project Management Association. (2014). IPMA Delta Regulations and Guidelines. International Project Management Association.
Kerzner, H. (2001). *Strategic Planning for Project Management Using a Project Management Maturity Model*. Retrieved from https://books.google.rs/books/about/Strategic_Planning_for_Project_Managemen.html?id=ggujIuwubmYC&pgis=1
Project Management Institute. (2003). Organizational Project Management Maturity Model. Project Management Institute.
Todorović, M. L., Petrović, D. Č., Mihić, M. M., Obradović, V. L., & Bushuyev, S. D. (2015). Project success analysis framework: A knowledge-based approach in project management. *International Journal of Project Management*, *33*(4), 772–783. doi:10.1016/j.ijproman.2014.10.009
Wendler, R. (2012). The maturity of maturity model research: A systematic mapping study. *Information and Software Technology*, *54*(12), 1317–1339. doi:10.1016/j.infsof.2012.07.007

SUSTAINABILITY AND PROJECT MANAGEMENT – WHERE IS THE LINKAGE?

Danijela Toljaga-Nikolić*, Marija Todorović, Dragan Bjelica
Faculty of Organizational Sciences, University of Belgrade
*Corresponding author, e-mail: toljagad@fon.bg.ac.rs

Abstract: *The paper is aiming at providing the insight in one challenging issue that organizations and managers are facing with – linking sustainability with project management concept. Nowadays, managers attempting to integrate the concept of sustainability into organizational strategies, programs and projects, and it becomes a real challenge. How to embed environmental and societal issues in a way that project delivers expected outcomes? The paper presents different aspects of sustainability in a project management, including four-dimensional conceptual framework for managing sustainable projects. Since the traditional project management concept is mainly focused on time, budget and scope (regarding quality), now it becomes challenging how to consider equally and involve three aspects of the sustainability concept: social, environmental and economic aspects.*

Keywords*: sustainability, project, project sustainability, project management*

1. INTRODUCTION

Sustainability is a challenge for companies and managers today. This phenomenon is recognized as an organizational goal that companies integrate into their strategies, plans and actions. Managers are trying to include ideas of sustainability in different business areas, and project management is no exception. It could be said that every tendency to integrate sustainability into project management actually involves the entire project management process which indicates how complex this idea is. What is expected to happen as a consequence of sustainability concept integration into the project management process? Generally speaking, companies seek for increased market share and increased profits.

Today it is important to do business as a socially responsible company and, at the same time, companies are faced with growing clients and government demands. Under these circumstances, managers are searching for the best way to satisfy every stakeholder and responsibility for customers' needs satisfaction is also a quite important step. Sustainability in a project management can be seen as the project ability to maintain its operations, services and benefits during its life cycle (Khan, 2000). To meet sustainability goals, companies should be able to make sustainability as a required and measured part of project management process. By managing this process, added-value for all project stakeholders could be ensured.

2. LITERATURE REVIEW

Sustainability concept is analyzed globally and as a widely dispersed one (Lozano et al., 2015). UN World Commission on Environment and Development defined sustainability as "a form of progress that meets the needs of the present without compromising the ability of future generations to meet their needs" (UN World Commission on Environment and Development, 1987). According to this definition, an element of sustainability is the aspect of future orientation and concern for future implications. Also, the same report includes statements of both social and environmental perspectives, and states that "in its broadest sense, sustainable development strategy aims at promoting harmony among human beings and between humanity and nature".

(Silvius & Schipper, 2014) completed a structured review of 164 books, book chapters and papers, and identified areas of impact which provide base for project sustainability consideration, e.g. project stakeholder management, project risk management, project portfolio management, etc. The authors concluded there are a growing number of publications that relate sustainability to project management. The importance of this burning issue is recognized by leading professionals and researchers in the project management field as well. The relationship between sustainability and project management is considered as one of the important developments in project management (Labuschagne & Brent, 2006). At the 22nd IPMA World Congress in 2008, IPMA Vice-President Mary McKinlay stated in the opening keynote speech that "the further development of the project management profession requires project managers to take responsibility for

sustainability". It indicates the importance of taking responsibility for the project results which includes the sustainability aspects of that results.

Definition of project management suggested by the Project Management Institute is widely accepted and, it refers to applying knowledge, skills, tools and techniques to project activities to meet the project requirements (Project Management Institute, 2008). Since sustainability includes multi-dimensional perspectives, such as economics, social and environmental aspects, sustainability should be included in all these aspects of project management (Marcelino-Sadaba et al., 2015).

Project deliverables can have social, economic and environmental impacts with longer lasting than projects themselves (Sanchez, 2015). Aligning portfolio selection and monitoring with the principles of sustainable development requires procedure (selection based on project cost and contribution to organizational goals). According to (Fernandez-Sanchez et al., 2010), a project is sustainable when three dimensions of sustainable development are improved, maintaining time, cost, quality and effort within an acceptable range. The sustainability principles are reflected in the definition or perception of project success. There is a strong link between sustainability in project management and project success. Todorović et al. (2014) stated about importance of measuring and analysing the project success, where success factors must be transferred to the operational level and become measurable.

Boswell et al. (2005) stated that it is difficult to achieve conditions for sustainable development and also not so easy to demonstrate that achievement. To achieve strategic sustainability objectives, project managers have to transform them into specific actions for projects. The necessity to move project management from the traditional approach toward a sustainable management is marked as a challenge and managing projects often requires dealing with organization factor that is sometimes beyond project manager`s control. Also, it is important to ensure that an organization is implementing projects that will reach stakeholders demands and its strategic goals by resolving portfolio selection problem. (Sanchez, 2015) recommends project portfolio selection based on the eco-impacts simultaneous analysis and analysis of the contribution to organizational goals.

An important phase in involving sustainable issues into project management is a clear understanding of the project life cycle and its phases (Sanchez, 2015). Different life cycles involved in a project interact mutually. Project life cycle is the life cycle where an idea is generated, developed and implemented. Asset/Process life cycle includes design, development, construction, implementation and removal of the service. And product life cycle recognizes the project deliverable as an idea that generates income for the company (Labuschagne et al., 2005) (Labuschagne & Brent, 2008). If we consider sustainability involvement in project management, then project life cycle should be taken into account (Labuschagne & Brent, 2006).

Maletic et al. (2014) pointed out that project management standards define several important management areas (products/services, stakeholders, processes) and they are, at the same time, aspects required for sustainable management. That makes project management as a good path for introducing sustainability in an organization (Bocken et al., 2014). Involving sustainability within strategic goals requires introducing innovation and learning from experience. Innovation can be considered as an important step for both business success and connect sustainability with project management (Amini & Bienstock, 2014).

3. DIFFERENT ASPECTS OF SUSTAINABILITY IN A PROJECT MANAGEMENT

The way of how society today is living, producing, consuming, etc. indicates that it might have negative effects on the life of future generations. This is why society today concerns about sustainability more than ever in every possible aspect. The traditional way of doing business cannot be called sustainable. Therefore, managers in organizations think about changes. The linkage between sustainability and project was established in 1987 by UN World Commission on Environment and Development, but today it could be said that sustainable society is seeking for projects since many changes in organizations are organized as projects (Sivius et al., 2012).

Based on the sustainability concepts, (Silvius et al., 2012) developed a working definition of sustainable project management: "Sustainable project management is the management of project-organized change in policies, assets or organizations, with consideration of the economic, social and environmental impact of the project, its result and its effect, for now, and future generations". The authors proposed project management processes, performance indicators, and competencies as areas in which project management has to develop in the future to capture the influence of sustainability.

Projects have an important role in the implementation of sustainable business processes and practices in organizations and therefore, project managers have a strong impact on the sustainability of organizations. According to (Silvius & Schipper, 2014), the project management standards failed to indicate the importance of the project managers' role in implementing sustainable development, and there is a certain competence gap of project managers concerning sustainability. To successfully introduce sustainability in organizations, (Silvius & Schipper, 2014) stated how crucial is to close this competence gap by the standards of project management competencies. The authors put the focus on five key-competences for sustainability: systems thinking competences, anticipatory competences, normative competences, strategic competences and interpersonal competences. By recognizing the importance of these competences, project managers will be well prepared for their crucial role in realizing sustainability of organizations.

According to Silvius and Schipper (2014), there are several differences in the characteristics of sustainable development and project management concepts.

Table 1: The differences between a sustainable development and a project management concepts

Sustainable development	Project management
Long term + short term oriented	Short term oriented
In the interest of this generation and future generations	In the interest of Sponsor / Stakeholders
Life-cycle oriented	Deliverable/result oriented
People, Planet, Profit	Scope, Time, Budget
Increasing complexity	Reduced complexity

The traditional concept of projects management and the concept of sustainable project management might be somehow in contrast. This is because in traditional concept, managers concern for time, budget and scopes (regarding quality), while now there are three elements that should be considered carefully: social, environmental and economic aspects (Daneshpour, 2015). (Marcelino-Sadaba et al., 2015) proposed a new conceptual framework that helps project managers in dealing with sustainability in projects (Figure 1). This framework is based on the assumption that following four dimensions are crucial for accomplishing sustainable project: *products* designed by using sustainability criteria, sustainable project *processes*, *organizations* committed to sustainability that carry out projects and *project managers* trained in sustainability.

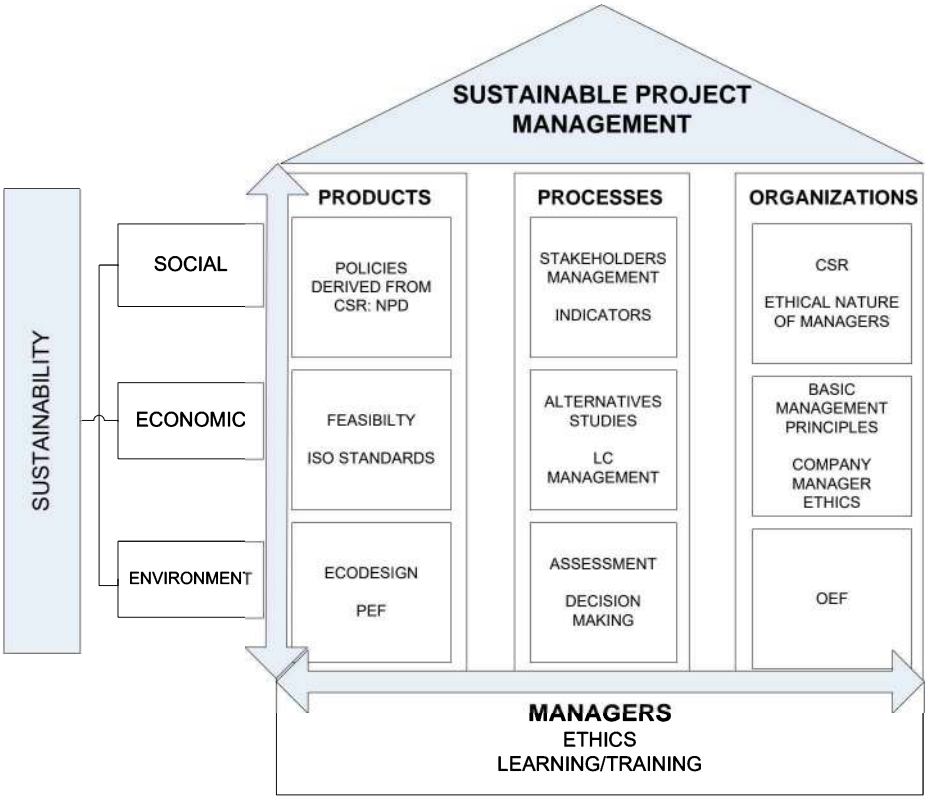


Figure 1: Four-dimensional conceptual framework for managing sustainable projects (adapted from (Marcelino-Sadaba et al., 2015)**)**

Figure 1. represents the conceptual model of the four dimensions of the sustainable project. Each dimension (products, processes, organization and managers) includes principles related to the three pillars of sustainability: social, economic and environment. The first dimension put focus on sustainable project products and the second one on the processes that help to include sustainability in the project. The third dimension relates to organizations that managing projects committed to sustainability and the fourth refers to project managers who are actually key players in linking sustainability and project management (Marcelino-Sadaba et al., 2015).

4. DIMENSIONS OF PROJECT SUSTAINABILITY

Project managers are seeking for ideas on how to make their projects more sustainable. Different authors, (Schieg, 2009) and (Goedknegt, 2012), pointed out that project managers have to take responsibility for sustainability. (Russel, 2008) stated that project manager`s position is excellent to influence operations within the organization to obtain greater sustainability. To include sustainability considerations in project management, project managers need to know dimensions of project sustainability. By knowing that, project managers increase the chances of project success. These dimensions have the potential to influence project sustainability and therefore has to be considered to ensure project sustainability. If any of these dimensions shows weakness, the sustainability of the entire project might be ruined. Dimensions of project sustainability are:

- Logistics dimension
- Economic dimension
- Community dimension
- Equity dimension
- Institutional dimension
- Environmental dimension (Khan, 2000)

Logistics dimension refers to the continued operation and the maintenance of project facilities. The question that can be asked is as following: Has the project received necessary support (both budgetary and institutional) to enable it to maintain required level of facilities?

Economic dimension refers to the continued flow of net benefits (for economic sector projects). Questions that can be asked are as following: Has all the cost and benefits under varying conditions weighted properly and does the project guarantee an acceptable level of financial and economic return?

Community dimension refers to the continued community participation (in projects where active community participation is crucial for both fostering new actions as well as for cost recovery). Questions that can be asked are as following: Has the project involved the community? Has it succeeded in maintaining a desirable level of participation of the community in the project activities?

Equity dimension refers to the equitable sharing and the distribution of project benefits. Questions that can be asked are as following: Has the project incorporated mechanisms that guarantee equitable access to and distribution of project benefits on a continuous basis?

Institutional dimension refers to the institutional stability. Questions that can be asked are as following: Has the project considered the institutional requirements and thus made provisions so that management support to project operations continue, during the life of the project?

Environmental dimension refers to the maintenance of environmental stability. Questions that can be asked are as following: Has the project considered environmental implications so that negative impacts on the environment are either avoided or mitigated during the life of the project? (Khan, 2000)

5. CONCLUSION

Sustainability and project management are two disciplines that are closely linked. Nowadays, organizations are searching for the more sustainable approach on project management. Organizations need change, and that change is organized in projects because these projects are likely to make a contribution to the organization sustainable development. To meet sustainability goals, managers should be able to make sustainability as a required and measured part of project management process. And, in order to define, implement and measure sustainability in the project, project managers should establish project management processes and procedures that could help in meeting sustainability goals. Also, project life cycle should be taken into account as a cycle where an idea is generated, developed and implemented.

The concept of project sustainability includes several dimensions that managers need to know to increase the chances of project success. Four-dimensional conceptual framework for managing sustainable projects can be used as a model where each dimension: products, processes, organization, and managers, includes principles related to the three pillars of sustainability: social, economic and environment. Still, there is a lot of effort that has to be involved in implementation of the sustainability concept in the management of projects.

Acknowledgments

This paper is the result of the project of basic research "Exploring modern trends of strategic management of the application of specialized management disciplines in the function of the competitiveness of Serbian economy", no. 179081, funded by Ministry of education, science and technological development of the Republic of Serbia.

REFERENCES

UN World Commission on Environment and Development. (1987). *Our Common Future.* Great Britain: Oxford University Press.

Amini, M., Bienstock, C. (2014). Corporate sustainability: an integrative definition and framework to evaluate corporate practice and guide academic research. *Journal of Cleaner Production, 76*, 12-19.

Bocken, N.M.P., Short, S.W., Rana, P., Evans, S. (2014). A literature and practice review to develop sustainable business model archetypes. *Journal of Cleaner Production, 65*, 42-56.

Boswell, J., Wallace, B., Boswell, P. (2005). Project sustainability management: translating words into action. *Civil engineering: Magazine of the south African institution, 13*(8), 12-15.

Fernandez-Sanchez, G., Rodriguez-Lopez, F. (2010). A methodology to identify sustainability indicators in construction project management - application to infrastructure projects in Spain. *Ecological Indicators, 10*, 1193-1201.

Goedknegt, D. a. (2012). The Implementation of Sustainability Principles in Project Management. *Proceedings of the 26th IPMA World Congress*, 875-882. Crete: IPMA.

Hosein Daneshpour. (2015). Integrating Sustainability into Management of Project. *International Journal of Environmental Science and Development, 6*(4), 321-325. doi:DOI: 10.7763/IJESD.2015.V6.611

Khan, M.A. (2000). *Planning for and monitoring of project sustainability: a guideline on concepts, issues and tools.* UNDP.

Labuschagne, C., Brent, A.C. (2006). Social indicators for sustainable project and technology life cycle management in the process industry. *International Journal of Life Cycle Assessment, 11*(1), 3-15.

Labuschagne, C., Brent, A.C. (2008). An industry perspective of the completeness and relevance of a social assessment framework for project and technology management in the manufacturing sector. *Journal of Cleaner Production, 16*, 253-262.

Labuschagne, C., Brent, A.C., van Erck, R.P.G. (2005). Assessing the sustainability performances of industries. *Journal of Cleaner Production, 13*, 373-385.

Lozano, R., Carpenter, A., Huisingh, D. (2015). A review of "theories of the firm" and their contributions to corporate sustainability. *Journal of Cleaner Production*, 430-442. doi:doi:10.1016/j.jclepro.2014.05.007

Maletic, M., Maletic, D., Dahlgaard, J., Dahlgaard-Park, S., Gomiscek, B. (2014). Sustainability exploration and sustainability exploitation: from a literature review towards a conceptual framework. *Journal of Cleaner Production, 79*, 182-194. doi:http://dx.doi.org/10.1016/j.jclepro.2014.05.045

Marcelino-Sadaba, A., Gonzalez-Jaen, L.F., Perez-Ezcurdia, A. (2015). Using project management as a way to sustainability. From a comprehensive review to a framework definition. *Journal of Cleaner Production, 99*, 1-16. doi:http://dx.doi.org/10.1016/j.jclepro.2015.03.020

Marisa Analia Sanchez. (2015). Integrating sustainability issues into project management. *Journal of Cleaner Production, 96*, 319-330. doi:http://dx.doi.org/10.1016/j.jclepro.2013.12.087

Project Management Institute. (2008). *A Guide to the Project Management Body of Knowledge (PMBOK Guide), fourth ed.* Newtown Square, PA: Project Management Institute.

Russel, J. (2008). Corporate Social Responsibility: What It Means for the Project Manager. *PMI Global Congress EMEA.* Malta: PMI.

Sara Marcelino-Sadaba, Luis Felipe Gonzalez-Jaen, Amaya Perez-Ezcurdia. (2015). Using project management as a way to sustainability. From a comprehensive review to a framework definition. *Journal of Cleaner Production, 99*, 1-16. doi:http://dx.doi.org/10.1016/j.jclepro.2015.03.020

Schieg, M. (2009). The Model of Corporate Social Responsibility in Project Management. *Business: Theory & Practice, 10*, 315-321.

Silvius A.J.G., Schipper, R.P.J. (2014). Sustainability in Project Management Competencies: Analyzing the Competence Gap of Project Managers. *Journal of Human Resource and Sustainability Studies, 2*, 40-58. doi:http://dx.doi.org/10.4236/jhrss.2014.22005

Silvius, A. S. (2014). Sustainability in project management: a literature review and impact analysis. *Social Business, 4*(1), 63-96.

Silvius, A.J.G., van den Brink, J., Kohler, A. (2012). The impact of sustainability on project management. In H. Linger, & J. Owner (Eds.), *The Project as a Social System - Asia-Pacific Perspectives on Project Management* (p. 300). Monash University Publishing.

Todorović, M., Toljaga-Nikolić, D., Mitrović, Z. (2014). Project Success Analysis: Evidence from Serbia. *"New Business Models and Sustainable Competitiveness" SYMORG 2014*, 1429-1435. Zlatibor, Serbia: Faculty of Organizational Sciences.

PUBLIC ADMINISTRATION MANAGEMENT 1095

THE PROCESS OF DECISION MAKING AT LOCAL LEVEL; BASED ON THE MODEL OF THE CITY MUNICIPALITY OBRENOVAC 1096
Ašković Bojana

PUBLIC SERVICE INTERFACE SOLUTION BASED ON BACK OFFICE INTERCONECTION FOR E-GOVERNMENT DEVELOPMENT: A MACEDONIAN CASE STUDY 1102
Bogdanoska Jovanovska Mimoza, Blazevska-Tabakovska Natasa, Vlahu-Gjorgievska Elena

INSTITUTIONALISM AND ORGANISATIONAL LEARNING IN THE PUBLIC PROCUREMENT MARKET 1108
Jaško Ondrej, Čudanov Mladen, Savoiu Gheorghe

EMBRACING THE OPEN DATA INITIATIVE IN REPUBLIC OF SERBIA 1116
Vidojević Branislav, Milčić Marija

DEVELOPMENT OF SYSTEM FOR COORDINATE AND EFFICIENT RESPONSE TO CYBER INCIDENTS 1125
Jovanovic Svetlana, Drakulic Mirjana, Vucenovic Tamara

RESEARCH IN THE FUNCTION OF IMPROVEMENT OF PUBLIC PROCUREMENT LAW 1133
Vukmirović Jovanka, Jovanović Predrag, Vukmirović Dragan

PUBLIC ADMINISTRATION

MANAGEMENT

THE PROCESS OF DECISION MAKING AT LOCAL LEVEL; BASED ON THE MODEL OF THE CITY MUNICIPALITY OBRENOVAC

Bojana Ašković
City Municipality Obrenovac
Corresponding author, e-mail: askbojana@gmail.com

Abstract: *The article deals with determination of the concept of direct citizen participation and analyze its main features. The primary goal of this research is to determine the key characteristics and the actual development rate of the four levels of direct citizen participation at local level: informing, consulting, proposing and participating in decision making; based on the model of the City Municipality Obrenovac.*

Keywords*: citizen participation, mechanisms of citizen participation, decision making, city municipality Obrenovac*

1. INTRODUCTION

Citizen participation in the public affairs of a community is considered to be one of the basic conditions to introduce democracy completely. It is also a crucial characteristic of life quality. Local policy is the corner-stone of democracy since it provides participation at the highest level possible. Citizen participation in the public affairs of a community creates new forms of social relations and represents engagement of each individual in decision making with reference to them and their immediate community (Vukelić, 2009).

This project has two primary goals. The first one is to determine the key characteristics of the concept of direct citizen participation at local level and the second one is the analysis of the actual development rate of the four levels of direct citizen participation at local level: informing, consulting, proposing and participating in decision making; based on the model of the City Municipality Obrenovac.

Depending on the author, citizen participation can refer to a wide range of similar but different issues. With reference to the concept of devided power and decision making, civil participation could be defined as a process in which society members, who are not engaged either in politics or establishment, devide power with public employees when it comes to making crucial decisions and carrying out activities with reference to community (Milosavljević et al., 2006). In conclusion, citizen participation represents all the activities of citizens aimed at having influence on making political decisions.

Direct citizen participation can be manifested at all the levels of government, but it is the most feasible at local level. First and foremost, the reason is the size of the departments. It is common within the following sectors: education, health service, social service, ecology, economy and communal service development, etc. Citizens can also take part in analysis, initiation, formulating, carrying out and evaluation of different decisions. Methods of direct participation are numerous and various, therefore citizens have a variety of possibilities for participation at their disposal. The most important are the following ones: referendums, assemblies of all the citizens, national or civil initiative, citizens meetings, panel discussions and other forms of colective political consulting, communication by eletronic media and the Internet, participating in polls, passing information on local government initiatives to citizens and obtaining information from the part of the citizens, submitting petitions, suggestions, requests and complaints from the part of citizens, addressing local authorities with public criticism, taking part in activities organised by interest groups, local media or citizens associations, nongovernment, humanitarian, professional and other citizens associations, informal colective activities, neighbours initiatives, neighbours" councils, protests, peacefull gatherings, demonstrations, school boards and other consulting authorities, individual forms of participation such as charitable and philanthropic work, organised funds raising for mutual interests e.g. local voluntary tax, etc.

City Municipality Obrenovac is one of 17 Belgrade municipalities. According to Law on local self-management and Law on capital city, the City of Belgrade, as the unit of local government, is entitled to define in its statute the following issues: territory organisation, responsibilities, organisation and responsibilities of the authorities, forms of direct decision making on the part of the citizen and other vital matters important for implementing rights and duties of the city. Constitution of the Republic of Serbia and the above mentioned laws do not define "city municipality" as a unit of local self-management. Therefore they cannot be directly implemented on city municipalities. For the same reason, the City of Belgrade is given an explicit authority to define position of city municipalities within its statute.

2. FORMS OF CITIZEN CONTRIBUTION- CLASSIFICATION

There are different forms of citizen" participation and decision making at local level of government. Typology given by Bogoljub Milosavljević has been chosen for the purposes of this project because it is, on one hand thorough and systematic, and on the other one relevant to concrete conditions in Serbia, i.e. legally stipulated forms of direct citizen" participation in the country. In this sense, there is a difference among the following forms of citizen" participation: (a) *informing* – which refers to passing information on work, plans and intentions of representative authorities to citizen and providing them with other sorts of information of public interest; (b) *consulting* – which includes different forms of citizen participation referring to deciding on priorities for the local community, such as panel discussions, public discussions, consulting by electronic media and the Internet, participating in the consulting sector; (c) *proposing* – which includes various forms of citizen participation in making proposals and expressing criticism on the part of work of representative authorities, such as citizen" meetings, petitions, individual proposals, complaints, forms of public criticism, protests, peaceful gatherings, demonstrations, etc.; (d) *decision making* – which refers to the forms of direct democracy, i.e. direct citizen" participation in decission making. It includes assemblies of all the citizen, referendums, citizen" initiatives and forms of local self-management (Milosavljević et al., 2006).

2.1 Informing

Passing information on work of municipal authorities and their plans is the basic condition for equal rights of citizen" participation in decision making. An individual, who is not informed, is not in a position to take part in managing the activities of the local community accordingly, nor to influence or control the work of the authorities. Therefore, passing information on the work of all the authorities in public is the principle confirmed by all the relevant international and local legal documents. The process can be made difficult if some of the potential problems arise, such as one-way direction in passing information – from municipal authorities to citizen – and directions to provide the flow of feedback information are not developed enough. News in the media, pamphlets, brochures, etc. are the most often used means in one-way communication between the authorities and the citizens. There is a danger of making public only basic data about meetings held, regulations and reports, while many of the important notices are not presented in public. Citizens are deprived from their right to participate in municipality management. Under the conditions mentioned, especially when citizens are informed at the late phase of planning or decision making, citizen are not in a position to influence the programmes made for „their own well being".

The Statute of the City Municipality Obrenovac defines that making work public can be done in the following ways: publishing bulletin and informative booklets, cooperation with the media, presenting decisions and other acts in public, designing web presentations, organising public discussions and in other situations according to the statute and other acts of the city municipality authorities (The Statute of the City Municipality of Obrenovac). City Municipality Obrenovac shows the initiative to inform the citizens on its activities and future plans. There is a tendency to make it easier for citizens to realise their rights and provide them with timely, precise and high quality information on the work of the city municipality. In order to improve passing information to citizens, Municipality of Obrenovac has created and developed methods which provide greater rate of being informed on the part of citizens, openness and transparency of work of the local government and easily and timely information availability, especially concerning current municipal acts to all the citizens (in printed or electronic form). Methods of passing information used by the Municipality of Obrenovac are the following: web site of the municipality (only last year, on the municipality web site is published 813 articles); e-mail (on official e-mail municipality receives about 150 e-mails per year and sends the same number of answers; municipality also uses mailing lists for passing information); social networks profiles (on daily level Facebook and Twitter accounts have several posts or links. Official Facebook account has 9063 likes and Twitter account has 1408 followers); public announcements of municipal representatives in the media (public announcements, statements and taking part in talk shows, press conferences); publishing and distribution of occasional publications, brochures, informative booklets (during the year Municipality Obrenovac publishing and distribution from five to ten publications, brochures or informative booklets); public meetings with citizens in local community centres (more than 20 meetings per year); council and assembly meetings which are open to public and representatives of the media (60 meetings are year average).

There is more space to introduce greater transparency into functioning of the city municipality, especially within the range of the following: public decision making process (announcing agenda for assembly and council meetings); availability of information on the work of city municipality – each citizen should be provided with access to information (by organising public database, using information technology, simplifying administrative procedures); adequate passing information to the public on administrative authorities and their organisational structure; as well as passing information to citizens whose interests are influenced by a current procedure, sending them a report on the development of the procedure and contact details of the person in charge.

2.2 Consulting

Consulting is the form of participation in decision making which gives citizens the opportunity to decide on the priorities of local community in cooperation with municipal authorities. Consulting citizens, collecting their proposals and complaints includes two-way process in which the authorities ask for and receive citizens" opinion on certain issues which are of mutual interest for both parties involved. With difference to informative process in which citizens are the consumers of information, in consulting process authorities are the user of information provided by citizens. Legally stipulated methods for this form of participation are the following: panel and other forms of political consultations, public discussions, consulting by electronic media and the Internet, taking part in different consulting teams, etc (Milosavljević et al., 2006).

Public discussions are one of the important forms of citizen participation. Public discussions offer each individual opportunity to consider every single local issue and reconsider critically in order to come to adequate solutions. However, realising a public discussion can include serious disadvantages: inadequate announcement of the date and place of the discussion to be held, choosing the time for discussion that could be inadequate for certain groups to attend meetings, choosing the venue that could be inadequate in terms that its capacity is limited and can provide place for a small number of interested citizens, etc. Besides, it is often the case that public discussions are only used for providing legitimacy for already made decisions and therefore, they are not intended to active cooperation and decision making. It is usually done through consultation with selected experts, and the final proposal is passed to the public as information, which can be talked about, but which cannot be changed. If there is no openness and readiness on the part of politicians and administration to respect contribution of all the participants in discussion, public discussion is only a screen to provide legitimacy for already accepted aims, and citizen do not consider their contribution is worth it.

In the Municipality of Obrenovac it is a common practice to have an annual public discussion during the procedure of municipal budget verification. Citizens are invited to fill in a questionnaire in local community centres, municipality building hall or online and to make their proposals for creating budget for the coming year. The same citizens are invited to attend public discussion where received proposals are discussed about. Discussion is also attended by municipal representatives and managers of public companies. Experiences so far indicate that citizens are not interested in this form of participation, although the number of received proposals based on the questionnaire is always considerable. Lack of interest for public discussions is probably consequence of bad experience, lack of time, inadequate time of the event and apathy.

Consulting citizens by the Internet – in technologically advanced countries the Internet has become important means of communication between citizens and different levels of authorities and place where citizens gather to discuss different issues. It has greatly influenced relationship between authorities and citizens and made it more complex and diverse.

Municipality Obrenovac uses the following forms of communication between citizens and authorities: municipal web site – with option which offers asking questions and making comments under the news announced (these kind of questions and comments are not common); citizen service “Answer in two days” (more than 200 requests per year); profiles on social networks (Facebook and Twitter) are actively used for consulting on different priorities of local community. Several times a year municipality organises online campaigns for collecting proposals for different purposes (most often for infrastructure improvement, taking care of the place and surrounding public area). According to Population, household and flat register in Republic of Serbia in 2011, 54 % of citizen in Obrenovac aged 15 and over are computer illiterate (they do not use computers). It could be concluded that communication between authorities and citizens on the Internet is at the developing stage. The reason is lack of knowledge and use of modern communication technologies. Therefore it is necessary to develop and promote off line tools for consulting as well.

Participation in the work of various advisory bodies – taking part in dealings through councils of assembly and municipal consulting councils is the right of citizens. It is an opportunity to express opinions of professionals and distinguished citizens, no matter what their political attitudes are.

Unfortunately, in the Municipality Obrenovac members of the working bodies of the Assembly and of the commissions of the Council are delegated by political parties, so participation in the work of these bodies is the opportunity to implement the party goals and target target groups, not to present ideas for the improvement of life in the local community. Municipality Obrenovac has 5 working bodies of the Assembly with a total of 25 members and 12 commissions of the Council with a total of 84 members. However, the Youth Council of Obrenovac is an example of good practice of this form of citizen involvement. Council members were elected after a public invitation for nomination of candidates for members was announced. The Council of Youth comprises three representatives from public services and institutions, one

representative of student parliaments, two representatives of two largest parliamentary groups, one representative of youth organizations and informal groups. In the municipality of Obrenovac the following forms of consultation are also used: public forums, expert meetings with representatives of the institutions, thematic discussions with citizens' associations, surveys, boxes for complaints and suggestions, books of impressions, chatting with citizens which is realized through "open door" method, collection of comments and suggestions regarding some topics in a particular period.

The strongest recommendation for the improvement of this form of civic participation is a wider introduction of various methods for consulting citizens.

2.3 Proposing

Proposing, as a form of participation, involves putting proposals forward and criticism of the work of the authorities. Compared to the level of information and consultation, proposing involves a higher degree of citizens' influence on decisions taken by local authorities. It can occur in many different forms of collective (public meetings, petitions, peaceful protests, gatherings, demonstrations) or individual (individual suggestions, complaints, petitions) character.

Citizens' meetings are gatherings organized in closed areas of the municipality intended for discussions and suggestions on matters within the competence of the municipality. The Statute of the municipality of Obrenovac defines the mode of convening such meetings, how they work and state their attitudes. The bodies of the city municipality or local community are obliged, within 60 days from the date of the citizens' meeting, to consider citizens' requests and suggestions, to take a stand on them, make an appropriate decision or measure, and inform the citizens.

Petition and public criticism include citizens' right to put forward proposals, suggestions, requests and criticism to the authorities. In Serbia, there is no precise legislation on petition, so petition is viewed as a non-binding citizens' appeal. Accordingly, the deadlines for replying are largely extended, which creates a sense among the citizens that this means is inefficient (Milosavljević et al, 2006). Consequently, citizens do not initiate or sign petitions to the extent they would if there were more confidence in the positive outcome of these activities. The Statute of the Municipality of Obrenovac contains no provisions on the right to petition.

In the past five years there were not organizing citizens' meetings, but there were two petitions. One of them was against refinery near the river and the second one was for dog playground in the town. Both of them were successful. However, in the Municipality of Obrenovac the practice of organizing citizens' meetings, and filing of petitions and public criticism has not been recorded.. The main initial recommendations for improving this aspect of civic participation is that it should be positioned and defined. The Statute and the decision of the Municipal Assembly should define and regulate it as a flexible form of citizen participation, which will provide an opportunity for groups and individuals to, as simply as possible, express their opinions and proposals on matters within the competence of the local government bodies.

2.4 Decision making

Direct (participatory) democracy is based on direct and continuous participation of citizens in government. Citizens can be directly involved in the process of making important political decisions at the local level in different ways. Referendum and Citizens' Initiative are the most common form of decision-making today, that is, of the implementation of direct democracy at the local level (Civic Initiatives, 2009).

The Statute of the Municipality of Obrenovac also provides for referendum and citizen initiative (in addition to citizens' meeting) as forms of direct citizen participation in the performance of urban municipalities. However, it should be noted that only a referendum is a form of decision-making, while the citizens' initiative is a form of previous plea in which citizens propose to the Assembly and other municipal bodies to solve an issue using their decisions. The above-mentioned forms of direct participation of citizens provide protection in cases where elected representatives do not make decisions that are in the interest of all.

Referendum is a form of participation that allows for direct voting at the polls on various issues that are of importance to the community. The Statute of the Municipality of Obrenovac allows a referendum to be announced on the own initiative of the Municipal Assembly or at the request of citizens. However, the statute does not precisely define a range of issues that can be decided by referendum, nor the times when it must be carried out. It is generally considered that the referendum should be organized on the occasion of "big things" such as the mayor or a shift of defining priorities for capital investment in the municipality.

Citizens' initiative gives citizens an active role in the management of municipal policy and represents the right to propose solutions to certain questions or bring in certain acts. The Statute of the Municipality of Obrenovac defines it that citizens, through the Citizens' Initiative, propose to the Assembly of the City

Municipality, within which a particular issue within the jurisdiction of the municipality of the city will be regulated, change of the Statute or other acts and call a referendum. The Assembly of the City Municipality is obliged to hold a hearing on the proposal from the citizens' initiative and to submit a detailed reply to citizens within 60 days of the receipt of the proposal.

Citizens in the Municipality of Obrenovac do not use referendum or citizen initiative as a mechanism for citizen participation although they represent two fundamental forms of direct citizen participation in decision-making. Encouraging this form of direct citizen participation is possible by the introduction of new, or, if necessary, by improvement of the existing legislation that allow: citizen initiatives seeking the elected bodies of local government to resolve the issue raised in the citizen initiative, or to initiate a procedure for calling a referendum; advisory referendum or referendum in which decisions are made on issues of interest to the local community, which local authorities are carrying out on its own initiative or at the request of the local community.

When analyzing the lack of public participation in decision-making we should not neglect research results (Zdenka Milivojević) which indicate that the majority of Serbian population, accustomed to strong and (all) powerful state, still does not see themselves as citizens responsible for their own rights and obligations, but still view themselves as (subordinate) inhabitants whose life is in the hands of the state and whose problems are a matter of state institutions' concern. Such attitudes narrow the space for civil initiatives. In addition, citizens are insufficiently informed about both the existence of decision-making mechanisms, as well as about the method and the reasons for their application.

3. LOCAL COMMUNITIES

The Statute of the Municipality of Obrenovac provides that, in order to meet the needs and interests of direct relevance to citizens from a certain area, local communities be established in the city municipality. The local community is established for one or more villages and, as a rule, covers an area with approximately the same population. The local community considers issues related to the creation of better conditions of life in the local community. The work of the local community and the real participation of citizens in exercising their right to local governance largely depends on the determination of funding for the implementation of programs and tasks of the local community. In the Municipality of Obrenovac there are 29 local communities, out of which 25 are villages. In the elections for local communities of 2012 the members of local community councils were elected by direct citizen votes and this was the first time that members of local community councils had been elected in this way. This practice, however, has not been continued. Local community councils play an important role in decision making, especially those related to the creation of better conditions of life in the local community. Communication between the authorities and citizens of the local community is better in rural local communities, because citizens of the village rely more on the local community than those living in the town.

4. CONCLUSION

Most citizens do not feel participant in the decision-making process in their local community and they are insufficiently informed about the developments and plans of the local authorities. Many are not aware at all that direct forms of participation exists in their municipality. Generally speaking, citizens are poorly informed and are rarely willing to use the existing mechanisms to contribute criticism of the government or make proposals. Launching initiatives to solve certain issues and improve life in the community, is rather the exception than the rule. Also, rare attendance to meetings where proposals or decisions of the authorities are discussed further alienates citizens from the decision-making process (SCCM, 2006). While Obrenovac Municipality is making efforts to improve citizen information and consultation, it is noted that proposals and decisions are not present, nor is anything done regarding the mechanisms for their encouragement. The efforts of municipalities are merely a single - action practice, but not a systematic and continuous approach to strengthening and fostering civic participation. Recommendations for greater citizen participation are openness of the local authority, stronger dialogue between local authorities and the citizens and sharing responsibilities in local public life.

Openness of the local authority to citizens is the first step towards greater citizen participation and the achievement of a democratic society. Informing citizens, their right of access to documents of the local government and timely and adequate information are indisputable prerequisite for deeper direct involvement of citizens. Transparency, public disclosure of the minutes and decisions of local authorities, organization of modern information services, live communication with the citizens and creation of cities' and municipalities' web domains are some of the recommended forms of active information.

Dialogue between local authorities and the citizens is the second part of the process of citizen direct participation in public life at the local level. Citizens' right to petition and public criticism or public debate are

some of the forms through which dialogue between citizens and local authorities may occur. Better and more accurate organization of dialogue with citizens, specification of mandatory issues that citizens must be consulted about, establishment of the obligation of local authorities to respond to the suggestions, remarks or criticisms of citizens, participation of citizens in working and advisory bodies, better and more frequent organization of public hearings or the introduction of innovative forms of consultation, are the guidelines proposed.

Sharing responsibilities is a key part of citizen direct participation in local public life. Developing their awareness of belonging to the community and encouraging citizens to undertake the responsibility to contribute to public life, are aimed at improving the dialogue between citizens and their elected representatives and the exercise of citizen right to participate directly in decisions making important for the future of their community (SCCM, 2006).

Organization and promotion of citizen direct participation can and should be focused on the formal and informal forms and methods of involving citizens in local public life. The system should work to raise awareness and responsibility for democratic participation of citizens in public life and decision-making. Finally, openness, dialogue and sharing responsibilities for build up a long-term partnership between citizens and local authorities. The goal of each local government should be building of a community of competent and aware citizens who will be ready to fully assume their role in society.

REFERENCES

Civic Initiatives (2009). *The participation of citizens in the process of drafting and implementing laws and other instruments of public policies*. Civic Initiatives, Belgrade, 28-33

Milivojević, Z. (2006). *Civil Society in Serbia: suppressed during the 1990s - in search of legitimacy, recognizable role and recognised influence during the 2000s*. Argument and the Centre for Development of Non-Profit Sector, Belgrade

Milosavljević, B. (2009). The *system of local self-government in Serbia*. Standing Conference of Towns and Municipalities, Belgrade

Milosavljević, B., Popadic, D., Logar, S. (2006). *Citizen participation at the local level - analysis of the legal framework and policies in Serbia and other European countries*. Standing Conference of Towns and Municipalities, Belgrade

The Standing Conference of Towns and Municipalities (2006). *Direct participation of citizens in public life at the local level*. Standing Conference of Towns and Municipalities, Belgrade, 11-49.

The Statute of the City Municipality of Obrenovac

Vukelić, J. (2009). *Direct participation of citizens in decision-making at the local level in Serbia*. Institute for Sociological Research, Faculty of Philosophy, Belgrade, 291-312.

PUBLIC SERVICE INTERFACE SOLUTION BASED ON BACK OFFICE INTERCONECTION FOR E-GOVERNMENT DEVELOPMENT: A MACEDONIAN CASE STUDY

Mimoza Bogdanoska Jovanovska[1], Natasa Blazevska-Tabakovska[1], Elena Vlahu-Gjorgievska[1]
[1]Faculty of information and communication technologies, Bitola, R.Macedonia
*Corresponding author, e-mail: mimoza.jovanovska@fikt.edu.mk

Abstract: *The core of e-government efforts is focusing on citizen-centric orientation with more user-friendly interfaces for the citizens. This paper has a purpose to present user-friendly interface solution for one public service for citizen in the e-government framework that takes part in smart city development. The proposed interface solution is based on back-office connections of whole stakeholders included in the process of public service issuing that belongs to the "life events" category. The offered solution is based on deep research in the area of Civil Registration in Macedonia, with focus on back-office connections in this public service delivery.*

Keywords*: e-government, back office, public services, interface, smart city*

1. INTRODUCTION

Cities are the future of humankind. In the last two century is noticed fast enlarging of the population that live in the cities: if in the 18th century less than 5% of the global population lived in a cities (Harrison and Donnelly, 2011), now, in the 21st century, in general at least 53% of the humankind lives in the cities (data related to 2014, http://kff.org/global-indicator/urban-population/) what is 10 times more than in the past. In the developed countries in the world as USA, United Kingdom, Japony, Russia, Germany, France, Spain, and many others, this number is between 75% and 91%, what point out that living in the big cities in the developed countries is bigger trend. Macedonia is no exception even belongs to the group of undeveloped countries – in 2014 arround 65% of the population in the country live in the cities.

The challenges that are emergence as a consequence of this trend within the cities caused problems like: lack of places to live, contamination, damaged or inadequate infrastructure, lack of effective health and education, poverty, low transparency of government, etc. Public administration institutions usually are located on different locations in the cities and very often there are long distances between them, what is also a part of the challenges of the smart city.

The revolutionary discovers of the last century that marks the way and style of life of this century (information and communication technologies (ICT), Internet and digital technology) are seen as the tools that offer possibilities for solving those above mention problems. The emergence and development of "Internet of things" opportunity arose much of everyday objects and processes to be controlled automatically by the Internet. Those tools enable the cities evoluation from traditional to smart city where the improving of the quality and efficiency of citizens lifes is highlight of the efforts.

E-government as an interdisciplinary scientific field that is on the intersection of computer, information, administrative, and political sciences (Bogdanoska Jovanovska et al.,2012), is a predecessor of smart city concept. Its focus on identifying opportunities and developing solutions based on ICT used in public administration domain by interconnection of the whole stakeholders involved in the public services delivery, have a great contribution to the process of facilitating the lives of the citizens in the big cities, where long distance between institutions are one of the biggest problem.

Based on the research of Bogdanoska Jovanovska et al. (2012): document analysis on relevant laws, procedures; survey on web-sites of public administration institutions; and interviews with servants included in the process of life events service delivery, related to Civil Registration area in Macedonia, qualitative information relevant for back office interconnection between relevant stakeholders involved in life events public services that belongs in this area were collected. Drawing of information flow network between all relevant institutions (public or business) included in the process of this life event realization was used as base for creating front office solution for one public service in this area: issuing Marriage Certificate. The final goal of this paper is creating the most user-friendly interface for front-end service realization of this e-service, based on well defined back office database connections between all involved stakeholders in the service delivery.

Further on the paper is organized as follows: next section gives the description of the civil registration area in RM, after that back office database connection by using information flow network is discussed Interface

solution public service – issuing Marriage Certificate is presented as fourth section. The conclusion with directions for further work concludes the paper.

2. DESCRIPTION OF CIVIL REGISTRATION AREA IN REPUBLIC OF MACEDONIA

The Civil Registration Area is a segment of the public administration in the Republic of Macedonia that utilizes the recording of crucial events related to citizens, i.e., changes in citizens" personal status from birth to death. More specifically, the Civil Registry records births, marriages (and all modifications) and deaths. In the Republic of Macedonia, birth, marriage and death certificates are commonly required and used for performing numerous distinct public services. The activities of the Civil Registry are within the sphere of competence of the Registrar Office, a legal entity within the Ministry of Justice of the Republic of Macedonia, established in 2010. The Registrar Office functions on the local level, through its 8 regional offices, 26 local offices of the departments for register operations and 239 local offices in rural settlements. The traditionally service delivery in this area - issuing the certificates for all events means realization of few steps: (1) citizens obligatory need to visit local offices that belongs to the city/municipality where the event happen (birth place, marriage place or death place); (2) fulfilling application for the certificate that the citizen needs, (3) completed all need documentations as support (personal identification card, identification card of the parents, prove of payment realization for that certain service issuing, etc.); and (4) when the certificate is ready, citizen needs to visit office again to take the certificate.
Currently, there isn"t any offered on-line public service organized as front-end in Republic of Macedonia. The information for public services mainly is available at one general web portal of e-government services in RM (www.uslugi.gov.mk) and specifically, the information related to issuing Marital Certificate is given at an official web site of the Registrar Office of RM (www.uvmk.gov.mk). At the general web site citizen can takes information for all public administration institutions in RM (ministries, biros, or other institutions) as well as the documents that the citizens need for issuing any of the public services that those public institutions offer. Registrar Office is part of this web page with all information also related to the issuing Marriage Certificate. The way of finding this information is quite complicated because the citizen needs to know which public institution issue this document. Additionally complications exist because up to 2010 this document was issued by the Ministry of Justice in the premises of Ministry of Interiors, and now this is duty of the new institution named as Registrar Office. Further on, as was already mention above, citizens can use second possible web site http://uvmk.gov.mk/?q=taxonomy/term/13 where he/she can see the form of the document in two versions: in Macedonian and in two languages form. If citizen click at given option (on left side) “documents” all document that Registrar Office issue are listed. The citizen does not have option to start procedure electronically for getting the document – Marriage Certificate.

3. BACK OFFICE CONNECTION IN THE PROCESS OF MARRIAGE CERTIFICATE ISSUING

For the purpose of presenting back-office interconnection between institutions (public and/or business) in the process of Issuing Marriage Certificate, i.e. for a visualization of the network, we use the Pajek software package (Batagelj and Mrvar, 2007) for social network analysis.
The network on the Figure 1 corresponds to the situation at the field, traditional realization of the process after the reform that took place in 2010 and involved establishment of the Registrar Office.

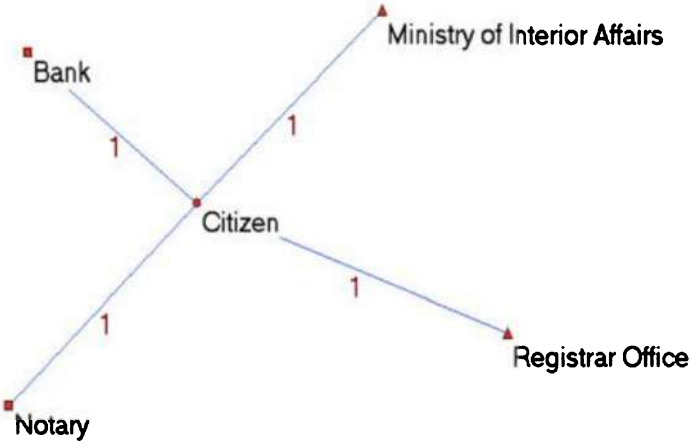


Figure 1: Information-flow network for the service "Issuance of marital status certificate”

The inter-organizational network presented at the Figure 1 is related to the information and document flows between public administration bodies and other stakeholders involved in the process of certain service

delivery: issuing of Marriage Certification. It is the traditional way of this certificate issuing where „the citizen" is in the center of the network – he/she has a role to connect the different stakeholders in the process of issuing public service.
According to the analyses that specifically focus on qualitative evaluation of e-services and European Commission DG Information Society (2001), four-stage model for the assessment of public-services online sophistication (EC1 model) is proposed:

1) information: the information necessary to start the procedure to obtain the public service is available online;
2) one-way interaction: the form (for printing or downloading) to start the procedure to obtain this service is available online;
3) two-way interaction: electronic intake with an electronic form to start the procedure to obtain the service including a form of physical or juridical authentication is possible;
4) transaction: covers full electronic case handling so that no other formal procedure is necessary for the applicant via paperwork; complete treatment of the public service is possible via the website, including decision, delivery and payment if required.

Above described public service delivery indicates that realization of this public service-issuing Marriage Certificate in Macedonia belongs to the first level of e-government development.
Electronically realization of this public services in the scope of e-government means back office connection of mention institutions, „behind the scene" documents interchange and information between public administration institutions as well as other stakeholders, and issuing document to the citizen without leaving its home, only by using some ICT device (computer, smart phone, credit card for payment, etc.). With other word saying: instead citizen to be in-line (traditional) he/she will realize this service on-line (e-government).
It is worth to mention Vintar et al. (2004) work on this problem, where the authors establish two dimensions of service maturity: sophistication and integration. The sophistication level according to them is defined according to the EC1 model, while the integration level according to the authors refers to "the degree of integration of service and corresponding processes required to solve a particular life-event problem:

1) dispersion: services needed to solve particular life-event are dispersed over different websites of different institutions;
2) coordination: services in the life-event are accessible through single entry point on the internet, but essentially services and corresponding processes remain unchanged;
3) integration: services and corresponding processes are integrated into one single process to solve the particular life-event in the whole."

Other very important thing for realization of this as well as any other public service on-line is interfaces that government institution offers to the citizen during the process of applying for public service realization i.e. submitting of the application. This part is important for two aspects: one – easy to use for every one even for those that have not high level of digital literacy, and second one (most important for us) solution that offer the best interconnections with all stakeholders involved in the process of that certain public service delivery, with all levels of controlling and cross-checking of the data that the citizen put in the process of application.
The process of electronically provision of public services includes two main parts: front office (portals, web sides) and back office (interconnections mainly between public administration institutions). Taking this in consideration "The provision of public services should be customer-oriented, taking their point-of-view: what the customers (citizens, business or even non-profit organizations) perceive in their relationships with public bureaucracy" (Vintar et al. 2004). So, motivation of the citizens to use portals/web sites depends of the user friendly interface of the portal as basic for easy managing of the services, as one side of the coin, and back office integration between public institutions, as other side on the coin, what is even more important, for functioning of the front office.

4. INTERFACES OF THE E-SERVICES

The crucial part of information system for using a smart government service is the user interface. Taking into consideration, many country governments take care about interface of the smart government services. For example, although the Singapore eCitizen portal had been assessed as the best of all analyzed portals already in the first measurement, it has improved from very good to excellent in the one-year period, which indicates that developers of the portal still take care of development of high-quality user-friendly public services (Leben et al., 2004).
The government services are used from beginners to experts (in term of using information system) and that is the main concern for interface designer. Most of the system users preferred an interface with small density (less than 50 percent of the interface to be filled with information). The experienced computer users preferred interface with higher density (sometimes approaching 90 percent occupancy of interface information). The designers are concern to offer interface that is easy to use or interface that allows quick access to necessary action/information. Sometimes these requirements are complementary but sometimes they lead to a completely different design decision. Beginners, for example, often prefer menus that show all the available

features of the system because they enable easy navigation and access. Experts, on the other hand, want menus organized around the most frequently used functions. The designers need to offer appropriate interface for all users, so they should try to balance between simple to use interface and interface with quick access.
Further, the user interface designed for public services, despite of principles for designing, should incorporate specific standards or document formats.

5. INTERFACE SOLUTION FOR ISSUING MARRIAGE CERTIFICATE

In the proposed case study, Issuance of Marriage Certificate (MSC), the user interface (UI) is created by using the official document as background for data entering (Figure 2).

Figure 2: User interface for issuing marriage certificate

The user should not enter all fields, but only those that contain the basic information needed for issuing marital status certificate. Elements which facilitate the entry (Figure 3) are used in the created UI:

a) Dropdown lists are used for choosing a city, municipality and place for delivering the certificate (e.g. the place where the marriage is concluded);
b) Entering dates is supported with datepickers (e.g. date of birth for each of the spouse, date of marriage, etc.);
c) Entering text - certain fields for text input are limited in length (e.g. identification number must be 13 characters), while some other fields are not limited (e.g. Entering mail address of the applicant).

By entering all necessary information, button for sending and processing the request is allowed. After the user sends the request for issuing the marital status certificate:

a) The information inserted by the user are checked within two institutions. When the information are validated the request is processed;
b) User receives an email with account and amount that need to be paid (costs for issuing the certificate);
c) After the validation of electronic payment, user receives an email with notifications for completed certificate and information about the delivering of the certificate (as shown in the request form - in the branch Registrar office or on home address).

If there are inconsistencies in the information entered by the user, he/she receives an email with further information that are needed for completion of the request.

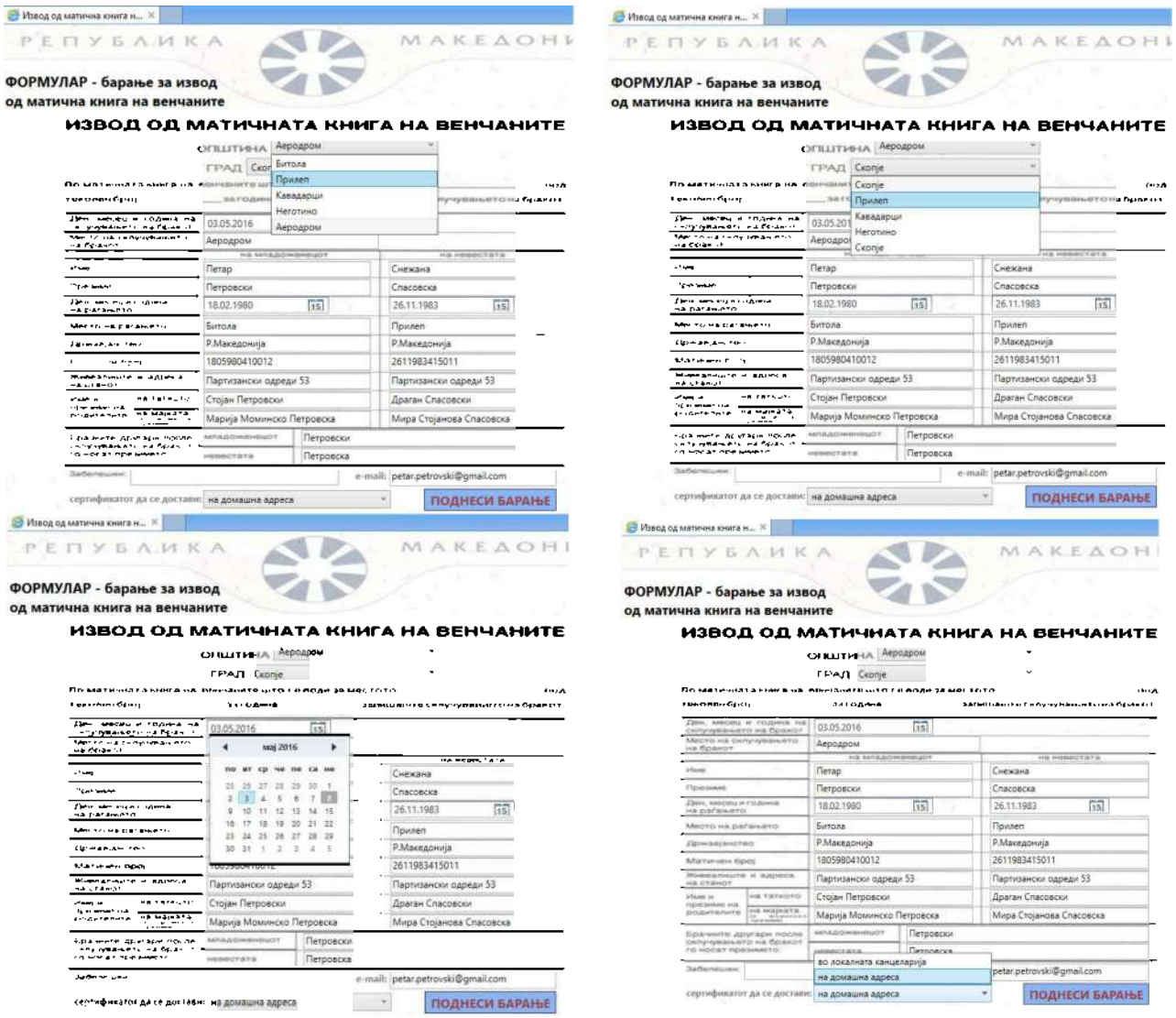


Figure 3: UI elements for facilitating the information entries

6. CONCLUSION

In this paper, based on dedicated research on front and back office situation in Republic of Macedonia related to issuing public service of Marriage Certificate, we propose interface solution for on-line realization of this service in context of e-government in direction with smart city development.

Having in mind that mainly websites and portals are examined from the governmental point of view and assessed upon the governmental offers for the customers (which is not always user friendly) we are offering solution that will be more suitable for people with low level of digital literacy. Furthermore, our interface solution (front office) is based on high level of back office development solution.

The advantage of the presented interface is not only the simplicity – intuitive data entry and reduced chances for errors. But more important, saving time and money, which is general attribute of e-services, and ability for the citizen to receive the certificate by mail on his/her home address or in local branch office by his/her choice (not in the municipality where the marriage is concluded).

The proposed interface solution has several characteristics that are important for citizen-oriented user-friendly e-government: usability, customization, openness and transparency. The advantage/strength offered by this interface solution reduces the burden of citizen (going from one to other institution for gathering need documentation necessary for getting Marriage Certification) and enabling the citizen from his/her home, at own PC starts/end procedure for getting this document.

The main purpose of this interface solution is actually the integration of various public and business institutions into a unified well coordinated back office system. We expected that the proposed interface will give successful results not only in increasing the citizen"s satisfaction, but also in improving of the overall effectiveness of service delivery process and public administration functionality.

It is essentially to emphasize that the approach of replacing the traditional e-services should be based on an analysis of back office and then creating the interface, which is not practice so far. Analyzes of back offices for different certificates on local and republic level, as well as adding new public on-line services can be done as further work.

REFERENCES

Batagelj, V., & Mrvar, A. (2007). Analysis of kinship relations with Pajek. Social Science Computer Review.

Bogdanoska Jovanovska, M., Erman, N., and Todorovski, Ljupco (2012). Indicators of intensity and development of e-government back-office. Indicators models, metrics and approaches for monitoring and evaluation of the situation in the public sector. Monograph. Faculty of Administration. University of Ljubljana.

Burgess, S., & Houghton, J. (2002). E-government user-friendliness of websites.

Clemen, R.T. (1996). Making Hard Decisions: An Introduction to Decision Analysis. Duxbury Press.

European Commission, DG Information Society. (2003, November). Top of The Web: Survey on quality and usage of public e-services [online].

Harrison, C., & Donnelly, I. A. (2011, September). A theory of smart cities. In Proceedings of the 55th Annual Meeting of the ISSS-2011, Hull, UK (Vol. 55, No. 1).

Leben, A., Kunstelj, M., & Bohanec, M. (2004, June). Evaluation of life-event portals: Trends in developing e-Services based on life-events. In 4th European Conference on e-Government, Dublin Castle, Ireland, 469-480.

TietoEnator Trigon, A. B. (2001). Benchmarking of electronic service delivery in the public sector. Executive report.

Vintar, M., Kunstelj, M., & Leben, A. (2004). Benchmarking the quality of Slovenian life-event portals, 208-221. Ashgate, Hampshire.

http://kff.org/message-about-global-health-facts/. Accessed on 1st of March 2016.

www.uslugi.gov.mk. Accessed on 16th of April 2016 [in Macedonian].

http://www.uvmk.gov.mk/. Accessed on 16th of April 2016 [in Macedonian].

http://uvmk.gov.mk/?q=taxonomy/term/13. Accessed on 16th of April 2016 [in Macedonian].

INSTITUTIONALISM AND ORGANISATIONAL LEARNING IN THE PUBLIC PROCUREMENT MARKET

Ondrej Jaško[1], Mladen Čudanov[2*], Gheorghe Savoiu[3]
[1, 2] University of Belgrade, Faculty of Organizational Sciences [3]University of Pitesti
*Corresponding author, e-mail: mladenc@fon.bg.ac.rs

Abstract: *Transaction costs represent one the most important elements of institutional economics. Their importance in studying current regulations and practice in public procurement domain is constantly growing due to the fact that production costs of bidders converge. Differences in regulations (institutions) and procedures related to public procurement create atmosphere that can significantly change negotiation outcomes. Bounded rationality, opportunism and imperfect information are identified as the key factors that generate transaction costs in public procurement. Organisational learning can influence a decrease in direct costs of closing a transaction, but cannot influence fundamental sources of transaction costs, such as uncertainty and risks.*

Key words: *transaction costs, public sector, organizational learning, bounded rationality, imperfect information, opportunism*

1. INTRODUCTION

Public expenditure in the Republic of Serbia accounts for 45.5% of GDP, which is similar to the Czech Republic and Poland, but more than Bulgaria, Romania, Croatia and Turkey (Veselinović, 2014). Most part of public expenditure (for many years it has covered over 50 per cent of Serbian budget) has been directed towards salaries in the sector, pensions and social benefits. The topic of this paper draws our attention towards the expenditures related to procurement of goods and services. Since the enforcement of the Public Procurement Law in Serbia, the share of public procurement costs in GDP has been monitored through reports of the competent state agency (according to official reports of Public Procurement Office), and it is found that public procurement accounts for 8 per cent of GDP. On the other hand, in reference countries (EU members above all), the value of public procurement (EU Commission, 2011) is about 3.5 per cent of GDP. Nevertheless, there are only few scientific studies that give attention to the analysis and conditions for improving efficiency and effectiveness of public procurement, particularly from the aspect of economic and organisational theory (Jaško et al, 2015). The aim of this paper, from the aspect of institutional economics, is to analyse the procedures and practices of public procurement and their influence on the efficiency of spending public funds (bearing in mind the possibility that the key factors of transaction cost levels can change), by applying the concept of organisational learning in public sector.

2. INSTITUTIONALISM THEORY AND PUBLIC PROCUREMENT

Today, transaction costs are inevitable part of public sector economy analysis and have their place in research papers and works of numerous theoreticians. On the other hand, it seems that there is no field with clearer reflection of this concept on practice than the field of public procurement. Numerous authors made their main contributions trying to connect the two research subject matters. Some of the most commonly mentioned relations between these two research subject matters are the issues of public choice (always related to decision-making in public administration) that were discussed by Brown and Potoski (2003) , Wals and Davis (1988). Mana, Matějková, Jurčík, Heidu (2014) expanded research on the issues of transparency, while Domberger and Jensen (1997), Reeves (2008) and many others researched into market-based public procurement. However, in this paper as well, it seems fair to give full credit to those whose contributions are in the basis of consistency and applicability of transaction cost concept, including a number of authors that are now considered to be the creators and developers of institutional perspective on economics.

Institutionalism is much older than its most significant result – transaction costs. Institutionalism was established on the works of those who followed the statement of Veblen that humans do not act exclusively

rationally and in accordance to their own interests, since their choices and decisions depend on tradition, customs, habits and other kinds of rules (e.g. laws, author's remark), so their natural surroundings, where they make their decisions, is social, i.e. institutional—(Veblen, 1899). North (1991) defines institutions as "humanly devised constraints that structure political, economic and social interactions". Constraints, as North describes, are devised as formal rules (constitutions, laws, property rights) and informal restraints (sanctions, taboos, customs, traditions, codes of conduct), which usually contribute to the perpetuation of order and safety within a market or society.

For example, let us observe the role of public policy makers. The first dilemma they have to face while deciding on which values to set upon their citizens is whether to offer a certain public service internally, through public services and enterprises, or externally, through private providers. Such dilemma is recognized in management of private companies as the question whether to ~~-m~~make or buy~~-~~. There are various factors, both in public administration institutions and public enterprises that can influence this decision, but Levin and Tadelis (2005) divide them into two separate groups – economic and political, while Brown and Potoski (2004) introduce a wide range of different factors. Some of the factors include city size, financial situation, i.e. indebtedness, specificities of procured goods or services, their susceptibility to quality changes, the possibility to measure the volume of provided services, etc. It is obvious that the answers to these questions are strongly related to the model of public sector, where there are examples of wide and narrow volume of public offices in different countries, and only partly to the economic effects achieved by different choices. Therefore, a decision is not only the result of choosing a good as such, but also of choosing the model of how to procure it and why that is useful, so the purpose of the good itself is sometimes disregarded, and attention is only given to the purpose of its procurement. Sometimes it seems that it is more important to procure goods and services in accordance to ´rules´, than to procure them under best economic conditions. Most commonly used public procurement rules are the ones that enable equal access and equal treatment in procedures, and transparency (Truchet, 2012).

A significant methodological difference between neoclassicism and institutionalism lies in the institutionalism concept that humans limit maximization preferences, which neoclassical economics built into the foundation of its microeconomic analysis that always takes into account the market participant, homoeconomicus' (Zabieglik, 2002). The economy based on homoeconomicus' can be seriously questioned if decision-making context is broadened, and if it is taken into account that humans always make decisions in social context , especially if they hold public positions, when from the level of individual interest, they move to a higher, common, general , or more specifically – public interest.

Neoclassical economics has been criticized because of its inability to deal with important and deep questions such as happiness and welfare, laws and justice (Gilboa, 2010). Rational choice is not always the one that maximizes the gain of the participants in transaction. It is usually considered in a broader context, including other people who are related to the transaction, but do not participate in it, and those who can have a future opportunity to make such transaction. These very consequences were first discussed by Pigue, who used them to establish his view on externalia, and then by Coase (1960), who called this effect - social cost transactions. Pigue's solution rests on taxation, which has to be conducted by the third party (the government) that does not participate in making the transaction, in order to reimburse the expenses to damaged parties on one hand, or to reduce undeserved advantages on the other. Coase's solution rests on direct negotiation between the parties, while the third party needs to create necessary conditions, so that the negotiation costs (transaction costs) tend towards zero (Coase 1960). Obviously, the costs of this kind of transactions will grow when there are lots of transactions (for instance, a lot of people living near a thermal power plant) and therefore most authors claim that the efficiency of Pigue's taxes will win over the low cost of Coase's transactions, which may result in transaction blockade. Apparently, inefficient contracting is one of very important aspects of institutionalism. If institutions are inefficient, they will not be used, or participants will tend to avoid them. Such examples of institutional inefficiency can lead towards improving institutional economy.

3. PUBLIC SECTOR AND PUBLIC PROCUREMENT INSTITUTION

Public procurement refers to the process by which authorities purchase goods and services intended to meet the needs of community, or that are necessary for proper functioning of public administration. It is clear that public procurement serves as means to obtain the goods that public sector cannot produce itself, or if it is not justified by economic or other reasons. The rules of public procurement, as compared to private sector procurement are not fully compatible to one of the key postulates that have been developed thanks to Coase (1937) and Williamson (1975). They noticed that a company or public sector in this case, will be developed

by vertical integration of transactions if that is the way to reduce total business expenses, which along with production costs include transaction costs, i.e. the costs of transaction realization. However, since the number of transactions is getting larger, it may not be possible to achieve the goal of reproducing market conditions within an organization, and the decision-making within an organization may become even less credible. So, these authors set the foundations for establishing company (public sector) limits in a cost-oriented way (Williamson & Winter 1991), but it is clear that the creators of public policies are not consistent in applying these rules when making decisions about public sector limits. That is how the demands for reducing public sector due to unsustainable accumulation of authorizations (Claus, 1984), neoliberal demands for introducing market mechanisms in public sector (Pierson, 1994), and demands of New Public Management representatives to transfer public authorizations to independent public agencies , all can be relevant at the same.

The number of people employed in public sector or public services that are conducted in public sector organization can be taken as a measure of changes of the rules applied in making decisions on how big public sector should be. Some relevant studies show that ~~"~~we separate evidence that downsizes work from evidence that does not (or equivalently here, that upsize work)" (Lee & Strang, 2006). Institutional approach provides several optimal solutions, which is one of its specific features as compared to neoliberal approaches in economy, and the forces that work towards applying one of the solutions are known as coercive, mimetic and normative pressures (Dimaggio & Powell 1983). As for the rules that are applied in public procurement domain in Serbia, it seems that all three sources had their respective roles in creating institutions.

Commons (1931) was the first to introduce the term ~~"~~working rules ~~"~~as a significant decision-making instrument, while Hamilton (1919) used the same explanation to introduce the term ~~"~~institutional economy— while trying to prove that development of economic principles has to overcome a passive position where economy is reduced to buyer-seller relationship. That relationship depends heavily on the rules that are being used between buyers and sellers, and that is the basis of institutional economics. Commons believed that economic problems which cannot be solved in market conditions can be solved in the conditions of institutional reforms, whereby he clearly pointed to strong relation between economy and law, which was in part, his key standpoint while being involved in establishing ~~"~~state of wealth" where he participated while taking part in numerous committees and forums in the USA. (Such commitment contributed to the fact that institutionalism is viewed as pre-interventionism).

One of the oldest regulations concerning public procurement refers to regulatory provisions that public procurement contracts between the state or its representatives and suppliers, have to be the result of tender procedure (Truchet, 2012) (public offers and competition), which has been mandatory in French legislation system since 1786, and on municipal levels since 1837.

4. APPROACHES TO INSTITUTIONAL CHANGES BASED ON ORGANISATIONAL LEARNING

Commons was also the first to introduce the term ~~"~~reasonable price" that referred rather to the procedure needed to get it, than to its amount. Namely, he points out that transaction price can be reached in negotiation process by gradually adjusting viewpoints, rather than by a discrete market mechanism with one price matching one type of goods. A price can vary depending on who sells, and who buys, but when ~~"~~a transaction has been contracted following a regular procedure, its value is guaranteed by the highest court of justice in the country—(Commons, 1931). The procedure is regular if it is transparent, if all the interested parties have access to it and if the same rules apply for all the parties.

One of institutionalism concepts is that both rules and institutions are historically changeable (Veben, 1899), not only because of the passage of time, which affects changes in social rules, but primarily because of technological progress. In the conditions of general application of ICT and orientation towards better efficiency and better results (Čudanov&Jaško, 2012), public procurement rules have been integrated into the procedures of electronic public procurement. Not only that public procurement procedures are now based on using electronic communication between the contracting authorities and bidders, but growing usage of electronic auctions emerges as the highest level of electronic procurement development.

A specific characteristic of electronic auctions in public procurement is that buyers, not sellers, initiate them. This characteristic causes another – the prices are getting lower, not higher, since the main goal is to obtain goods at the lowest possible price, while other conditions remain the same (quality, life cycle, payment terms, etc). Moreover, certain kinds of auctions enable bidders to change their bids several times, since they are familiar to the bids of other participants in the auction. Several auction procedures have been developed

and the most familiar type is called English auction (Abulaban & Qadah, 2006). The procedure is as follows: Contracting authorities determine reservation price (the highest they are ready to pay); bidders are not familiar with the reservation price; auction expiration time is determined; bidders are given chance to make their bids; after all the changes have been done in the given bids, the one with the lowest value will be chosen. In some cases, it is possible to limit the changes that can be done in the initial bid, which serves as a protective mechanism against speculative behaviour of the participants. Dutch auctions that are considered to have the most efficient procedure, from the perspective of buyer can begin with a symbolic price for the demanded good, which represents an offer to contracting authorities to accept the terms. Then the price gradually gets higher, and the first one who accepts the offered price wins the auction (Vicrey, 1961).

A thorough explanation of the effects such auctions have on the efficiency of public procurement was provided by William Vickrey, back in the 1960s, and many others since then. Today, they are integral parts of standard applications (SAP 2007) for procurement management not only in public, but also in most private companies. Except the mentioned ones, there are types of electronic procurement with elements of classical tender procedure and auction. *First-price sealed bid* is electronic procurement where no changes can be made to the initial bids, so it is the most similar to classic form of bidding, except that it is made electronically. *Second-price sealed bid* also does not let a bidder see other participants' bids. Bidders provide not only the price, but also the information on quantities they are ready to offer. What is particularly interesting is that tender winner will not pay the price he has offered, but the price offered by the participant who came second, which contributes to even greater price reducing (Abulaban & Qadah, 2006). Since the described rules can change the way bidders behave, several8 more options for auction procedures have been developed, especially for the English auctions, where 8bidders cannot see the value of other participants' bids, but only the sequence of bids, or they can only see their own and the leading bid, or the leading bid and/or the sequence of bids, without the values (Pridavok, 2011), etc.

Empirical inductive method has been used in developing institutionalism, as compared to neoclassical economics where abstract deductive method has been used for research and deduction (Bresser-Pereira, 2003). For example, the mentioned auction practice has become a rule that is now included into regulations in the field of public procurement, since it has been proved that such practice can improve both transparency and competitiveness of the procedure (Kumar & Chang, 2007). Nowadays, there are regulatory provisions about when and how auctions can be conducted in the public procurement process, which is an obvious example that institutions can also appear as results of experiments.

Institutions appear and change as the result of a long-lasting and incremental process of learning (Groenewegen, Spithoven & van den Berg 2010). Learning is recognised as:

- Improvement of performances and achievements.
- Memorising, or using the information from experience.
- Evaluation of knowledge, where learning means making changes in knowledge stock, its characteristics or distribution to units.

Knowledge obtained by improving processes and performances is at the very core of learning as presented by Nelson and Winter (1982), and it is achieved by codification of knowledge according to routines performed by individuals. That is ~~–~~learning by doing~~–~~access to learning. Routines are the result of a balance that appears between the forces that support changes and those that believe in the efficiency of current situations or processes. Routines are considered to be a form of organizational control that does not engage resources, and therefore reduce transactional costs, which makes them even more efficient.

Organizational learning is a synthesis of two processes: learning and dissemination of knowledge. Learning demands the existence of certain mechanisms that enable members of an organization to collect, analyze, distribute and apply knowledge, which can be done in classical manner, with technology enhanced learning (Čudanov et al 2012) or in blended learning approach (Mijatović et al, 2013; Horvat et al, 2015). Some of the mechanisms of knowledge dissemination in the field of public procurement have also been turned into rules, and what is more – into formal rules. For example, professionalization of clerks working in public procurement field is decidedly required by legislation through since each contracting authority is obliged to have at least one licensed clerk for the job. Certain exams have to be taken in order to get the license, and the acquired knowledge has to be improved by constant training throughout the year. The subjects to learn about are regulations, routines and procedures in public procurement.

Natural sequel, or special kind of evolutionary approach to establishing institutions is Path dependence theory. It was introduced by Nelson and Winter (1982) and was in accordance to North's understanding of how institutions are created. Institutions also appear as incremental connection between the past and the

future (North, 1991), being the result of collective learning that evolves from informal into formal institution, which again proves that the inductive method lies at the heart of institutionalism. Evolutionary process has to be understood as transformation process of cumulative changes, where the result of each modification or transformation, at a certain moment makes the conditions where future reproduction and transformation can take place (Martins, 2009). That is why the mentioned electronic procurement and electronic auctions in the bidding process are not an innovation, but a technologically advanced replica of the procedures that have been occurring in trade, or even procurement for decades, or even centuries. Electronic procurement is an example of adaptive learning (Argyris & Schön, 1978) because the basic set of postulates on how routines should look like is not reconsidered, but the changes in technology used to conduct them.

It has to be noticed that certain differences still exist in degrees of innovation and transformation in evolution processes (Tsang & Zahra, 2008), on the basis of which continuous and discontinuous changes can be distinguished. A continuous change is less intensely different from the previous situation or procedure. It is introduced as a continuous change of cumulative character, which means that it contains larger or smaller share of the previous situation and is conducted by continual updating of the existing organizational routines. Discontinuous change is discrete, caused by a decision or action of the participants in a process. It is much more intensely different from the previous situation or procedure. Discontinuous changes are usually conducted to make important strategic shifts, when the crisis is fully developed and is often followed by deposition of managers. Discontinuous change comes as a result of generative learning, or double-loop learning (Argyris & Schön, 1978), because it affects basic postulates of previously developed routines. As regards public procurement, centralization and decentralization can be the examples of such changes.

5. AMOUNT OF TRANSACTION COSTS AS A CRITERION OF PUBLIC PROCUREMENT EFFICIENCY

Transaction costs can be defined as costs related to the activity that needs be conducted, so that a certain product or service can be transferred from one organizational system to another (Jaško, Čudanov, Jevtić & Krivokapić 2013). More operative definitions of transaction costs, which describe their contents, point out that all costs except the costs of production (providing services) are transaction costs. Some authors explain the structure of transaction costs as a process, which makes it easier to identify them within the procedures of public procurement. They claim that transaction costs are the costs related to the process of connecting to markets, and specifically, they include ~~-c~~osts of negotiation and writing contingent contracts; costs of monitoring contractual performance; costs of enforcing contractual promises; and costs associated with breaches of contractual promises" (Rahman & Kumaraswamy, 20026).

While searching for operatively usable identification of transaction cost contents in order to conduct a research about transaction costs in the area of public procurement, it has been found that they can be divided into four categories: 1) research costs, 2) contract costs, 3) monitoring costs and 4) conduction costs (Williamson 1981; North 1991; Hennart 1993). Research costs include the costs of collecting market information related to supply, competition, etc. Contract costs include the costs of procedure to draw up and conclude a contract. Monitoring costs include the costs of monitoring whether each party fulfils obligations prescribed by the contract, while conduction costs include the costs of litigation and sanctioning contract parties which fail to fulfil their obligations (Dyer 1997).

What is it that generates transaction costs, what is it that influeces the level of costs, and vice versa, how is it possible to put them under control?

After Williamson (1975) identified the fact that the amount of transaction costs is heavily influenced by imperfect information, i.e. the fact that market decisions are made with incomplete information induced further search for finding answers to the given question. Next level of insight is that bounded rationality and opportunistic behaviour of market participants cause imperfect markets. Both bounded rationality and opportunism influence the amount of costs before and after a transaction, i.e. they can be *ex ante* and *ex post (Williamson 1975). Ex ante* bounded rationality is the result of inability to fully determine all specific qualities of a procurement subject, and to envisage all the circumstances that may appear during the procurement process. The more complex procurement object is, more time and recourses are needed to reduce or even eliminate this uncertainty. On the other hand, bidders need more time and resources to formulate their offer. *Ex post* bounded rationality generates costs of monitoring the contract execution and costs of making and accepting consumer complaints. On the other hand, bidders hedge against counterparty risk, currency swings, inadequate procedures on the side of contracting authorities while planning procurement, unjustified consumer complaints, etc.

Opportunism, which is defined as a tendency to gain personal interest by legal, but often morally unacceptable behaviour before or after closing a transaction, can also cause transaction costs (Williamson 1975). Information asymmetry suits opportunistic behaviour, since one party has more information on the subject matter of contract agreement, the conditions needed to conduct a transaction or the outcomes that will ensue (e.g. insurance holders hide risks (ex ante opportunism), or true facts about causes and amounts of damage (ex post opportunism)).

Competition level in the market is an important factor of the amount of transaction costs. If both bidders and contraction authorities can close a transaction with numerous participants in the market, opportunism risk is very low and thus the opportunism-based transaction cost. This observation is related to Williamson´s statement that bounded rationality and opportunism gain more influence by using asset specificity to conduct a transaction, by measuring service scope and frequency of transactions (Williamson, 1981). An asset is more specific if its use is limited to a smaller number of goods or services where it can actively participate in their reproduction. In this case, this specificity category does not include only funds, but also people needed to produce transaction subject. The greater number of specialists needed to realize transaction subject, the greater are transaction costs related to it.

If transaction subject is not easily measurable, both parties are burdened by measuring transaction efficiency, which can put pressure on them to show opportunistic behaviour in the process of creating and performing a contract.

Table 1: Classification of public services by specificity of investment and measureability of output

Specificity of investment / Output measurability	Low	High
Easy	Measurable market services • towing service • disposal of solid waste TrC: +	Measurable monopolistic services electric energy, gas and water supplying TrC: ++
Difficult	Non-measurable market services • public health services • social services TrC: ++	Non-measurable monopolistic services • Firefighters • Police TrC: +++

Key: TrC =total transaction cost

The expected number of transaction repetition also affects the outcome of negotiation. The easier it is to determine frequency and number of repetition, the lower is uncertainty, and thereby the cost calculated due to specific qualities of resources to be engaged. This is connected to the calculation influenced by the experience curve (Sallenare, 1985) in all the processes determined by certain routine.

While determining transaction costs contracting authorities and bidders do not calculate with the same values concerning specificity, measurability and frequency of procurement. A bidder can be a specialist for certain type of production, having economies of scale, while contracting authority may have this single purchase of that good. Contracting authorities and bidders may have different ideas about quantity of services or intensity of engagement in contract performance, which is not so relevant when it refers to products. Contracting authorities may intend to conduct a procurement every year, but a bidder assumes that it is going to be performed only this time. The consequence of such behaviour may be that transaction cost is not equally perceived by both parties. Since the price obtained in public procurement procedure is a result of negotiation, regardless of how it has been conducted, it can be assumed that the price will equal the sum of production and transaction costs of the party with bigger sum. The variation in price that can be achieved still needs to be determined by conducting research that will take into consideration not only negotiation results, but also negotiation processes, price convergence of both buyers and bidders.

6. CONCLUSION

Institutionalism introduced into economic analysis some new categories and perspectives on market relations and organizational dynamics within a system. Some fundamental categories of neoclassical economics have been challenged by introducing new approaches that include transaction costs, reasonable instead of market prices, negotiation as a procedure for obtaining a price, as opposed to supply and demand relations and prices that depend on negotiation methods. Institutionalism offers economic perspective on the

world that highly corresponds to organization of public procurement market and the degree of behavioural dependability on that market under the influence of regulatory institutions. Institutions make it possible to decrease transaction costs, since knowledge of transaction costs can decrease market imperfection, growing opportunism of the participants and can also increase efficiency in the entire public sector. In that market, institutions are viewed as dynamic categories that undergo changes under the influence of market participants´ learning, but due to progress in technology that is being used, as well. Knowledge improvement related to transaction costs that are generated by current institutions is a cornerstone for making changes in behaviour of both participants and institutions.

REFERENCES

AbuLaban, A. N., & Qadah, G. Z. (2006, May). Seller strategies for dutch online auctions. In *Electrical and Computer Engineering, 2006. CCECE'06. Canadian Conference on* (pp. 505-509). IEEE. ISBN: 1-4244-0038-4

Bresser-Pereira, L. C. (2003). Economics' Two Methods. Trabalho apresentado no Xv Encontro anual da European association for Evolutionary Political Economy, Maastricht.

Brown, T. L., & Potoski, M. (2003). Transaction costs and institutional explanations for government service production decisions. *Journal of Public Administration research and theory*, *13*(4), 441-468.

Brown, T. L., & Potoski, M. (2004). Managing the public service market. Public Administration Review, 64(6), 656-668.

Coase, R. (1960): The Problem of Social Cost, *Journal of Law and Economics*, Vol. 3, 1-44.

Coase, R. H. (1937). The nature of the firm. *economica*, *4*(16), 386-405.

Commons, J.R. (1931), Institutional Economics, *American Economic Review*, Vol.21, pp. 648 –657 Čudanov M., Jaško O., 2012, Adoption of Information and Communication Technologies and Dominant Management Orientation in Organizations. Behaviour & Information Technology (Print ISSN 0144-929X/Online ISSN: 1362-3001), Vol. 31 Iss. 5, 509-523.

Čudanov, M., Savoiu, G., & Jaško, O. (2012). Usage of technology enhanced learning tools and organizational change perception. Computer Science and Information Systems, 9(1), 285-302.

DiMaggio, P.J. & Powell W.W. (1983). The iron cage revisited: institutional isomorphism and collective rationality in organizational fields. *American Sociological Review* 48, 147-160.

Domberger, S. & Jensen. P. (1997). Contracting out in the public sector: theory, evidence and prospects, *Oxford Review of Economic Policy*, 13, 4, 67-79.

Dyer, R. O. (1997). Ethical Considerations to Multiple Representation in Construction and Surety Bond Litigation. Constr. Law., 17, 14.

EU Commision. (2011). Public procurement in Europe (2011) Cost and effectiveness. In: European Commission - The EU Single Market: Evaluation of public procurement rules. London, UK: London Economics and Ecorys.

Gilboa, I. (2010). Rational choice. Cambridge, MA: The MITPress.

Groenewegen, J., Spithoven, A. and A. van den Berg (2010), Institutional Economics - an Introduction, New York, USA: Palgrave Macmillan,.

Hamilton, W. (1919). The Institutional Approach to Economic Theory. *American Economic Review*. 9, 309 – 318

Hennart, J.F. (1993). Explaining the swollen middle: Why most transactions are a mix of ―Market" and ―Hierarchy". *Organization Science*, 4(4), pp. 529–547.

Horvat, A., Dobrota, M., Krsmanovic, M., & Cudanov, M. (2015). Student perception of Moodle learning management system: a satisfaction and significance analysis. Interactive Learning Environments, 23(4), 515-527.

Jaško, O., Čudanov, M., Jevtić, M., & Krivokapić, J. (2013). Projektovanje organizacije. Beograd, Srbija: FON.

Jaško, O., Jovanović, P., Čudanov, M. (2015) Cost Efficiency of Public Procurement at Local Level: Chances for Improvement of Local Self-government and Public Enterprises in Serbia. *Lex Localis*, 13(3), 789-809

Kumar S., Chang C.W. (2007). Reverse auctions: How much total supply chain cost savings are there? — A conceptual overview. *Journal of Revenue & Pricing Management*, 6, 77-85

Lee, C. K., & Strang, D. (2006). The international diffusion of public-sector downsizing: Network emulation and theory-driven learning. International organization, 60(04), 883-909.

Levin, J. & Tadelis, S. (2005). Contract ing for Government Services: Theory and Evidence from U.S. Cities. *Stanford Institute for Theoretical Economics*, online: http://www.stanford.edu/~jdlevin/research.htm . Mana, P., Matějková, J., Jurčík, R. & Heidu R. (2014). The key factors of transparency of the public procurement in the Czech Republic, Enterprise and the Competitive Environment 2014 conference, ECE 2014, 6–7 March 2014, Brno, Czech Republic

Martins, N. (2009), A transformational conception of evolutionary processes, Evolutionary and *Institutional Economics Review*, 6(1), 71-102.

Mijatovic, I., Cudanov, M., Jednak, S., & Kadijevich, D. M. (2013). How the usage of learning management systems influences student achievement. Teaching in Higher Education, 18(5), 506-517.
Nelson, R.R. & Winter S.G. (1982). An Evolutionary Theory of Economic Change. Harvard University Press, Cambridge, MA.
North, D.C (1991). Institutions, *The Journal of Economic Perspectives*, 5(1), 97-112.
Offe, C. (1984). Contradictions of the Welfare State. Cambridge, USA: MIT Press.
Pierson, P. (1994). Dismantling the Welfare State? New York, USA: Cambridge University Press.
Pridavok, M (2011). Stratégie v elektronických reverzných aukciách, International Scientific Conference Young Scientists
Rahman, M.M. & Kumaraswamy M.M.(2002). Joint risk management through transactionally efficient relational contracting. *Construction Management & Economics*, 20(1), 45-54.
Reeves, E. (2008). The Practice of Contracting in Public Private Partnerships: Transaction Costs and Relational Contracting in the Irish Schools Sector, *Public Administration* 86(4), 969 – 986.
Sallenave, J. P. (1985). The uses and abuses of experience curves. Long Range Planning, 18(1), 64-72.
SAP (2007) Reverse auction best practices: practical approaches to ensure successful electronic reverse auction events. SAP Whitepaper, available online: http://www.sdn.sap.com/irj/scn/index?rid=/library/uuid/b018b90a-b9e5-2910-c6bd-f8f7bc3a34a9 [last accessed 28th April 2016]
Truchet, D (2012): Basic Principles of the Public Procurement Procedure in France and the Influence of the EU Law, *HKJU – CCPA*, 12(4), pp. 1103–1116.
Tsang, E. W., & Zahra, S. A. (2008). Organizational unlearning. Human Relations, 61(10), 1435-1462.
Veblen, T.B. (1899). The Theory of the Leisure Class, New York, USA: MacMillan.
Veselinović, P (2014). Reforma javnog sektora kao ključna determinanta uspešnosti tranzicije privrede Republike Srbije, *Ekonomski horizonti*, 16(2), 141 – 159.
Vickrey, W. (1961). Counterspeculation, auctions, and competitive sealed tenders. The Journal of finance, 16(1), 8-37.
Walsh, K., Davis, H. (1988). Competition and services: The impact of the Local Government Act 1988, Department of the Environment, University of Birmingham, HMSO, United Kingdom
Williamson, O (1975), Markets and Hierarchies: Analysis and Antitrust Implications. New York, USA: Free Press
Williamson, O. & Winter, S. (1991): The Nature of the Firm – Origins, Evolution and Development, Oxford University Press, Inc.
Williamson, O. E. (1981). The economics of organization: The transaction cost approach. *American journal of sociology*, 548-577.
Zabieglik, S. (2002). The origins of the term homo oeconomicus. Economics and Values, edited by Janina Kubka, Gdansk, 123-131.

EMBRACING THE OPEN DATA INITIATIVE IN REPUBLIC OF SERBIA

Branislav Vidojević, Marija Milčić
Faculty of Organizational Sciences, Faculty of Organizational Sciences
branislav.vidojevic@outlook.com, marija.milcic@fonis.com

Abstract: *Open data as a term is being used more often than ever before. It is an initiative which represents the idea that some data should be available to everyone, without any restrictions. In this paper we described several formats for representing open data and we discuss which format should be used for data of specific nature. Also, we gave an example of open data based application, Serbian Parliament Open Data REST API. Finally, we describe legislation in Serbia concerning Open Data, in contrast to the laws of other more developed countries which could be considered as mature Open Data practitioners.*

Keywords: *OpenData, OpenParliament, GovernmentData, StartUp, entrepreneurship, SymOrg*

1. INTRODUCTION

Many companies and governments collect tremendous amounts of data in their regular work activities. Often, those data have only one purpose, and, after being used, those data are stored and probably never used again. The thing is that companies and governments maybe are not using those data, but someone could benefit of that kind of information. The concept behind open data is that some data should be available to everyone to use it, build upon it, make money of it and modify it and all that without any restrictions (http://opendefinition.org/od/2.1/en/). Open data initiative is becoming stronger and stronger as the time is passing by. The reason of such a trend is that more institutions are starting to see benefits of opening their data.

Why should someone put a lot of effort and time into releasing data to someone who just might use those data and benefit from it?

Several reasons to open data have been described by the authors of (Janssen et al, 2012), which can be summarized as follows:

- The first reason is that most of the data that should be opened is the data that is already publicly available. For example, governments must provide their citizens with certain information, but only when citizens request that information. That process is usually slow, not very effective, and it discourages people to ask for new information. In addition to that problem, format of the data that governments usually provide is not standardized, and it is in physical form, as paper, pictures etc.

- The second reason is that sometimes, companies and governments don't have enough resources to start a project and create a new value based on their data, but they know that it could be done. So, their motive could be to open their data to everyone, give example of usage, and wait for someone to do that work, or even to do a better job.

- The third reason is that there are lots of people that are great in their field of expertise who are eager to create new value from which they, or even the community, could benefit. By opening the data, companies and governments will give a push to the entrepreneurship spirit of that kind of people. More entrepreneurs lead to smaller degree of unemployment, which again lead us to better life quality, higher standards and better developed economy.

2. DATA QUALITY OF OPEN DATA

It is difficult to define data quality, because the perceived data quality differs from the one use case to another. A definition which is commonly used is that data is considered to be of high quality in correlation to fitness of use of that data (Zaveri et al, 2013). To be able to provide high quality data is of the utmost importance to understand the perception of the data consumer, who assess data quality based on several factors as accuracy, completeness, relevancy, consistency, availability, verifiability and timeliness. (Wang & Strong, 1996).

Tim Berners-Lee, the inventor of the Web, developed a 5-star deployment scheme for Open Data, which is widely used for determining the openness of the data (Berners-Lee, 2012):

- *1-star data*: To achieve one star on Tim Berners-Lee's scale, you have to make your data available on the Web, in any format, under an open license. It is the lowest score because the data is available on the Web, but it is difficult to process it, by hand or by machine. It can be said that data is locked-up in a document.

- *2-star data*: To achieve two stars, data has to be available as structured data which is structured using some proprietary software as Excel. Difficulty lies in data processability, because data consumer has to use same proprietary software as the data publisher, which represents an obstacle in open data context.

- *3-star data*: To achieve three stars, data has to be available on the Web in open format as CSV (Comma Separated Values). Now, everyone can find free tools to process those data. It is possible to publish data with ease. The problem is that data is not embedded into Web. Consumer has to search for new data to be able to use it and process it again, whenever he or she has a need for it.

- *4-star data*: To achieve four stars, data has to be linked to the specific URI (Uniform Resource Identifier). This means that others can pinpoint data using specific URI, bookmark data, reuse at will. It takes some time to organize data in the right way and to implement services, but it can produce great benefits to the publisher and consumers, such as better control over data, possibility to link data to other locations on the Web, and promoting it in that manner.

- *5-star data*: To achieve five stars, all it has to be done is to link existing four stars data to the other data on the Web. In that way, you can move through world of data, discover new data, interact with it, use it and reuse it whenever you wish to.

Quality and openness of data in Serbia is around three stars data. In year of 2015, official Serbia Open Data portal has been established (http://data.gov.rs/). In a moment of writing this paper, that portal had links to websites of other institutions in Serbia, like Ministry of interior, Ministry of Education, Science and Technological Development and several others. They have uploaded some of their data on their websites and data is mostly in CSV format. Their data is rather badly structured and difficult to find. Large number of databases and connections between those databases, without any open data regulatory entity, makes the task of opening the data quite difficult.

2.1 Open Data formats

In order to increase data quality, existing and widely used data formats should be used. Choosing the right file format depends on the nature of information data contains.

If data is published only once, without any need to change it afterwards, CSV, JSON (JavaScript Object Notation) XML, or any similar structured data format should be used. Chosen format must be machine processable, which means that file formats like PDF, Word documents, pictures or similar are not suitable for this purpose.

Comma Separated Values (CSV) format is used when dataset is relatively easy to represent in a flat structure. Tabular data in some proprietary format is not a good choice for opening the dataset and CSV file format should be used. There is no official definition of CSV file format, but RFC4180

(https://tools.ietf.org/html/rfc4180) gives a most standard recommendations how to use it (Tennison et al, 2015).

Example:

```
Marco,Polo,United States
```

Comma is used as a delimiter which delimits values of different properties. In this case, Marco is a name, Polo is a surname, and United States is an origin country of some person. Different persons are described in a separate rows.

JavaScript Object Notation (JSON) format is a lightweight textual format for data representation (http://www.json.org/). It can be used to represent even complex datasets. It is not dependent on any programming language, and it is easy to process it, even for humans. Nowadays, it is often used to replace XML format. Same data described in JSON format has smaller footprint (less bytes) than in XML format.

Example:

```
{
        “name” : “Marco”,
        “surname” : “Polo”,
        “country” : “United States”
}
```

JSON is a key-value structure. For every key, a value should be provided. A value can be a number, string, null value, boolean value (true/false), other JSON or array of JSONs.

Extensible Markup Language (XML) is widely used as a data-representation format. It is a reliable format, because there are a lot of XML Schemas which are used to represent the data structure of some XML document. If it is necessary to be sure that data are in right format, XML file format should be used. Each XML document has logical and physical structure (Bray et al, 2008). It is relatively easy to create validation schemas to be sure that document has a valid structure. Existence of many tools for processing and creating XML format documents represents great advantage of XML format.

Example:

```
<person>
        <name>Marco</name>
        <surname>Polo</surname>
        <country>United States</country>
</person>
```

We can see that same information has more text in XML format than in JSON format.

If data is being published regularly, creating an API (Application Programming Interface) should be considered. By creating an API, it would be possible to look up for data over HTTP protocol (Bizer et al, 2011). It would be easier to add new data through creating new URIs. In addition, updating the data would not be a problem because data would be available using same URI. Through API, different formats of data could be served, like JSON, JSON-LD (JSON Linked Data), XML, RDF (Resource Description Framework) etc.

3. EXAMPLE OF AN OPEN DATA APPLICATION

3.1 Purpose of the application

Open Parliament Data is a project with a purpose of opening data from the Parliament of the Republic of Serbia about its members, political parties, sessions and speeches to the public (http://147.91.128.71:9090/parlament/). In order to make the data from the Serbian Parliament available to the wider audience, we have developed, under supervision of Laboratory for Artificial Intelligence (http://ai.fon.bg.ac.rs/), an API that can be utilized by everyone without any limit. This API enables any programmer, data analyst, news reporter or any other interested party to easily access the data that was previously stored in databases, documents and internal records of the Serbian Parliament.

3.2 Data provider

Data was originally created by Serbian Parliament. Non-profit organization "Otvoreni Parlament" (http://www.otvoreniparlament.rs/) requested and got this data from Serbian Parliament. The same non-profit organization has created a MySQL relational database, has structured and siloed data in it and gave us the access to it in order to create REST API.

Database consists of data of more than 1100 parliament members, 160 thousands speeches, more than 1200 sessions and more than 70 parties from year of 2002 to year of 2012.

3.3 REST application development

REST is an architectural style which is based on web-standards and the HTTP protocol (Li & Chou, 2011). Open Parliament REST API was built using Java programming language. We used Hibernate framework to "map" the database. Mapping database tables enables transformation from relational to object model. So we represented every object with URI (Uniform Resource Identifier) in order to be able to get specific data record by specific HTTP GET request. For building REST API we have used Jersey framework. Jersey is an open source, production quality, serving as JAX-RS (JSR 311 & JSR 339) Reference Implementation for building RESTful Web services. Jersey provides a well-formed API so that developers may extend Jersey API to suit their needs. Our architecture is designed by well-known design principles, and it is easy to explore the opened dataset (Massé, 2012).

3.3.1 URI specification of the REST services

Every parliament member can be accessed by sending an HTTP GET request which follows the next pattern:

{domain name}/members/:id

Example: http://147.91.128.71:9090/parlament/api/members/12411

where :id represents specific identifier of every member.

To be able to get speeches of a specific member, URI has to be built in the following pattern:

{domain name}/members/:id/speeches

Example: http://147.91.128.71:9090/parlament/api/members/12411/speeches

where :id represents specific identifier of every member.

In order to access data of some specific political party, URI has to be built in the following pattern:

{domain name}/parties/:id

Example: http://147.91.128.71:9090/parlament/api/parties/476

where :id represents a specific identifier of every party.

In order to access data of members of a specific party, URI has to be built in the following pattern:

{domain name}/parties/:id/members

Example: http://147.91.128.71:9090/parlament/api/members/12411/members

where :id represents a specific identifier of every party.

In order to access data of a specific session, URI has to be built in the following pattern:

{domain name}/sessions/:id

Example: http://147.91.128.71:9090/parlament/api/sessions/889

where :id represents a specific identifier of every session.

To be able to get speeches from a specific session, URI has to be built in the following pattern:

{domain name}/sessions/:id/speeches

Example: http://147.91.128.71:9090/parlament/api/sessions/889/speeches

where :id represents a specific identifier of every session.

Also, it is possible to get data of a specific speech by building URI following pattern:

{domain name}/speeches/:id

Example: http://147.91.128.71:9090/parlament/api/speeches/409344

where :id represents a specific identifier of every speech.

There are possibilities to control number of results (limit, page), ordering (sort), date range (from, to) by setting values of the specific query parameters. It is also possible to search data for specific keyword by setting specific parameter (query).

3.4 Results and benefits of the application

This API has been developed to support Open Government Data initiative. This initiative in Serbia is just starting, so this kind of application can contribute to popularization of Open Data. In addition, this API was designed by Open Data design principles (Massé, 2012; Government service design manual, n.d.). That means that API is scalable, and learning curve of API usage is not steep. API is well documented, so others can use it with ease. Also, data and API are licensed under the Creative Commons license (https://creativecommons.org/licenses/by-sa/4.0/) so everyone can use, modify and redistribute the data for any purpose. Besides API, we have provided several examples to show usage of the created API (http://147.91.128.71:9090/parlament/). That will help others to quickly grasp principles of API usage.

Currently, application is in testing phase. Eventually it will be used by non-profit organization “Otvoreni Parlament” to provide application on their website to explore the given data (http://www.otvoreniparlament.rs/).

Source code of the application is stored at GitHub, with detailed manual how to start the project, to test it and even how to contribute (https://github.com/faculty-of-organizational-sciences/open-parliament-api).

3.5 Comparison with other similar applications

Open Data at the Scottish Parliament has the same RESTful architecture style, and provides information about core parliamentary business, informal work at the parliament such as cross party groups and awareness raising events and details about members including their contact details and their Register of Interests. While both applications have complete documentation, complex HTTP request and response examples and the same architecture style, the difference is in volume of the available datasets. Significantly larger amount of available data in Scottish open parliament makes conducting of complex statistic possible, which is currently not the case in our application (The Scottish Parliament, n.d.).

4. OPPORTUNITIES

Local and state governments around the world are becoming more aware that smart data management helps to create new opportunities for economic development, to increase the efficiency of service delivery, to improve citizens' outcomes and to increase citizens' participation in decision-making processes. Opening Data is globally recognized as a process that will significantly contribute to achieving the objective of sustainable development after year of 2015 (Cerović, 2016).

In Serbia there are several groups that are initiating opening of data sets from Serbian administration sphere. UNDP (United Nations Development Programme) has significant influence on data opening. They published Estimation of the readiness to open data, organized first competition for developing applications which use different data sets and organized conference "Open data: open possibilities'' (Cerović, 2016). ,,CRTA" (Center for research, transparency and accountability) (http://www.crta.rs/) is a group of activists and journalists, which influenced on institutions and public officials through monitoring and control of their work to increase their transparency of their regular work by opening their data. Their work resulted in providing several applications on the "Otvoreni Parlament'' (http://www.otvoreniparlament.rs/) website and "Prati pare" application. "Prati pare" application name translated in English means "Follow money" and the purpose of the application is to provide conditions for the responsible management of public funds and to increase the transparency of work of local authorities (http://www.pratipare.rs/).

The data value is in possibility of data usage. It is important to put pressure on the government services to open their data. In that way, they will recognize Open Data as a need they have to fulfill to be able to achieve economic prosperity by implementing socially important services for citizens. Socially important data has to be open by default, not open by request. Opening data can be initiated by civil society, the private sector, international organizations, donors and individuals, and even the state's administration.

According to the McKinsey Global Institute survey, open-data can be used as a significant factor of unlocking great economic value by minimizing the gap between different industries where traditional intuition based decision making would be replaced by data-driven decision making (Manyika et al, 2013).

Serbia has joined a partnership for open government in year of 2014 (http://www.opengovpartnership.org/how-it-works/dates-and-deadlines). Since then, more and more organizations have worked on open data initiative. As a result of three years of putting pressure on the government, UNDP in cooperation with SEE ITC and Norwegian Embassy organized a competition "Open Data Hackathon" (http://hakaton.rs/; Zrnić, 2015). The competition was 48 hours hackathon where programmers have been working on applications based on open data provided by several Serbian institutions. As a result of the competition, several socially useful applications have been made.

Organizations could use open data to improve their decision-making process. Analysis of open data enables companies to discover what users prefer, e.g. what are their desires and habits, in order to improve products and services and detect potential anomalies. By investing in technology for gathering, sharing and analysis of data, as well as standards for comparison using data from multiple sources improves the business models and production processes. Also, the meta-data (data about the data itself) further contribute to the usefulness of open data, because they help to acquire better insights into the characteristics and quality of the data.

Progress of some companies are based only on open data. Authors of this survey (PSI_Open data in business, n.d.) provided us with several examples:

Mobile App for events in Vienna helps Tourist Organization to promote events, and this application is only based on the open data from the catalogue data of the City of Vienna (http://itunes.apple.com/de/app/viennaevents/id442891364?mt=8&ls=1/).

Belgian company, Graydon Belgium, helps you to correctly assess and control the health of your business relations. You obtain all relevant and up-to-date information enabling you to evaluate financial situation of your possible business partners. A thorough financial analysis will help you make the right credit decisions. This application was developed thanks to open data of Belgium (http://data.gov.be/en).

5. LEGAL REGULATIONS

The first successful step towards to the opening of the data in Serbia is The Law on Access to Public Information, which describes procedure how to gain access into official documents, however, the law did not include open data as information of public importance. The most important contribution of this Act is the introduction of the Commissioner for Information of Public Importance and Personal Data Protection (United Nations Development Programme, 2013).

It is defined by the law (The law on Free Access to Information of Public Importance, 2007) that citizens have rights to require public information. In the Constitution (Republic of Serbia Constitution, 2006), it is clearly defined which information should be publicly available. Also, it is clearly defined which information must not be provided to public.

This question is regulated in accordance to the standards of The European Union, relating to the protection of personal data.

Serbia has signed the Convention on the protection of individuals with regards to automatic processing of personal data in September 2005, which was ratified by the Law on Ratification and which was passed in 2008. This helps us to make a distinction between which data we are able to request for and which we are not.

The regulations of this law which are associated with the opening of data are:

- In the section "Measures to improve public work of government authority" (The Law on Personal Data Protection, 2009) there is an Article "The obligation to publish a directory" in which is stated that state authorities are obliged, at least once a year, to create a data report such as descriptions of authority and organizational structures, information about the budget and means of work, types of services and other information in addition to the main data about its work.

- In the section "Measures to improve public work of government authority" (The Law on Personal Data Protection, 2009) there is an Article "Damage compensation" in which is stated that if the public information is not provided to a person who requested that information, public authorities have to compensate for damage if they had unreasonably denied to provide the requested information.

- Laws, decrees, regulations, official materials of state bodies and persons working at publicly important positions, as well as all official translations of these documents, are not considered as work of an author, but as public domain documents (The Law on Copyright and Related Rights, 2009).

When requesting for certain information to become publicly available, certain law regulations could be used (United Nations Development Programme, 2013):

- Law about state administration stipulates that work of public administration bodies is considered to be public. That means that they are obliged to inform public about their work, using medias or other appropriate way to inform public.

- Resolution of legislative policy stipulates that is necessary to ensure full transparency and openness throughout the process of passing the law.

- The National Assembly, the President and the Government have the right to disclose annulling the obligation of secrecy.

- Upon written request, the Department of Statistics and other authorities authorized to process statistical data can provide some information without identifying scientific and research institutions. The institution requesting the information must clearly indicate the usage purpose of these data.

- Different agencies have regulations governing their duties regarding the collection and storage of data.

The largest contribution to the opening of the data would be to establish a format in which information is reported, as well as licensing and further use of open data.

Legal regulation is very important and there are lots of governments that have published their Open Data laws. For example, Dubai Open Data Law, which allows sharing of non-confidential data between government entities and other stakeholders (WAM, 2015). United Kingdom Government has created the Open Government License (http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/) and public bodies now can publish their Crown Copyright material under this license.

6. CONCLUSION AND FUTURE WORK

Information is power, but only when it's on time and when it's available. Data can provide a lot of information but we can use it only if it is given in the right format. Power of open data can be used for fast development of small businesses. It will result in more employed people, a lot of different applications from which society can benefit greatly.

As a matter of future work, we will continue to maintain Open Parliament REST service. Also, we will implement new solutions like JSON-LD (JSON Linked Data) response format. We will try to popularize Open Data by giving open data workshops and passing our Open Parliament open source project to the community to help others to engage easier into Open Data projects.

REFERENCES

Berners-Lee, T. (2012). (5). star deployment scheme for Open Data. Retrieved April 16, 2016 from: http://5stardata.info/en/

Bizer, C., Heath, T., & Berners-Lee, T. (2011). Linked Data. *Semantic Services, Interoperability and Web Applications Emerging Concepts,* 205-227.

Bray T., Paoli J., Sperberg-McQueen C. M., Maler E. & Yergeau F. (November, 2008). Extensible Markup Language (XML) 1.0 (Fifth Edition). Retrieved May 15, 2016 from: https://www.w3.org/TR/xml/

Cerović, I. (2016, January 12). Open data: Open possibilities. Retrieved April 8, 2016 from: http://www.rs.undp.org/content/serbia/sr/home/ourperspective/ourperspectivearticles/otvoreni-podaci--otvorene-mogunosti.html

Government service design manual (n.d.), Open data - Accessible, machine-readable data about services. Retrieved May 12, 2016 from: https://www.gov.uk/service-manual/technology/open-data.html

Janssen, M., Charalabidis, Y., & Zuiderwijk, A. (2012). Benefits, Adoption Barriers and Myths of Open Data and Open Government. *Information Systems Management*, 29(4), 258-268.

Li, L., & Chou, W. (2011, July). Design and Describe REST API without Violating REST: A Petri Net Based Approach. 2011 IEEE International Conference on Web Services.

Manyika, J., Chui, M., Farrell, D., Van Kuiken, S., & Groves, P. (2013). McKinsey Global Institute - *Open data:* Unlocking innovation and performance with liquid information, Retrieved April 6, 2016 from: http://www.mckinsey.com/business-functions/business-technology/our-insights/open-data-unlocking-innovation-and-performance-with-liquid-information

Massé, M. (2012). *REST API design rulebook*. Sebastopol, CA: O'Reilly.

PSI_Open data in business (n.d.). Some European examples. Retrieved April 7, 2016 from: https://docs.google.com/spreadsheet/ccc?key=0Ams8fpz2_77XdEV0Q0VWQjJ6SXd0X0xOTi0tdUdHUXc#gid=0

Republic of Serbia Constitution (2006). In Serbian - Ustav Republike Srbije. Retrieved March 12, 2016 from: http://www.ustavni.sud.rs/page/view/139-100028/ustav-republike-srbije

Tennison J., Kellogg G. & Herman I. (December, 2015). Model for Tabular Data and Metadata on the Web. Retrieved May 14, 2015 from: https://www.w3.org/TR/tabular-data-model

The Law on Copyright and Related Rights (2009). In Serbian - Zakon o autorskim i srodnim pravima. Retrieved March 13, 2016 from: http://www.paragraf.rs/propisi/zakon_o_autorskom_i_srodnim_pravima.html

The Law on Free Access to Information of Public Importance (2007). In Serbian - Zakon o slobodnom pristupu informacijama od javnog značaja. Retrieved March 12, 2016 from:

http://www.paragraf.rs/propisi/zakon_o_slobodnom_pristupu_informacijama_od_javnog_znacaja.html

The Law on Personal Data Protection (2009). In Serbian - Zakon o zaštiti podataka o ličnosti. Retrieved March 9, 2016 from: http://www.paragraf.rs/propisi/zakon_o_zastiti_podataka_o_licnosti.html

The Scottish Parliament (n.d.). *Scottish Parliament Open Data*. Retrieved May 14, 2016 from: https://data.parliament.scot/#/home

United Nations Development Programme (2013). Assessment of readiness for opening data of Republic of Serbia. Retrieved March 31, 2016 from: http://www.rs.undp.org/content/dam/serbia/Publications%20and%20reports/Serbian/UNDP_SRB_ODRA%20SRB%20web.pdf

WAM, (2015, October). Mohammed bin Rashid issues open data law for Dubai Smart City. Retrieved April 8, 2016 from: https://www.wam.ae/en/news/emirates/1395286806353.html

Wang, R. Y., & Strong, D. M. (1996). Beyond Accuracy: What Data Quality Means to Data Consumers. *Journal of Management Information Systems, 12*(4), 5-33.

Zaveri, A., Rula, A., Maurino, A., Pietrobon, R., Lehmann, J., Auer, S., & Hitzler, P. (2013). Quality assessment methodologies for linked open data. *Submitted to Semantic Web Journal*.

Zrnić S. (November, 2015). Open Data Hackathon - Create software solutions for the usage of first publicly available datasets in Serbia. Retrieved May 15, 2016 from: http://startit.rs/open-data-hakaton-kreirajte-tehnicka-resenja-za-upotrebu-prvih-javno-dostupnih-podataka-u-srbiji/

DEVELOPMENT OF SYSTEM FOR COORDINATE AND EFFICIENT RESPONSE TO CYBER INCIDENTS

Svetlana Jovanovic[1], Mirjana Drakulic[1], Tamara Vucenovic*[2]
[1]University of Belgrade, Faculty of Organizational Sciences
[2]University of Belgrade, Faculty of Philology
* Corresponding author, e-mail: tamaravucenovic@yahoo.com

Abstract: *Traditionally, the main responsibility for safety of the society lies with the state. The particularities of cyber space, however, require the necessity of full cooperation of all segments of society since they can all be and are constant targets of cyber attacks. Many nongovernmental actors have more resources for cyber defence compared to the state: dominant resources are in the hands of private sector - telecommunications companies and providers, hardware and software manufacturers and large enterprises. Likewise, nongovernmental and academic communities often possess specific skills, analytic and research capacities, and international contacts in this field, as well as the potential to draw attention to possible violations of human rights. Therefore, it is of utmost importance to completely and actively include both private and nongovernmental sector, as well as academic communities, into strategic and operational activities at the state level and to establish multipartner cooperation based on mutual trust.*

Keywords*: CSIRT, CERCI System, cyber incident, cyber defence, cyber security*

1. INTRODUCTION

The safety of cyber space is one of the key topics and implies protection against damage, unauthorised use, and Internet, cyber space and user abuse. Therefore, network management is brought into focus of state and global policies due to the geo-strategic importance of network infrastructure, digital data flow and control, as well as due to its influence on new standards that will define the functioning of society in the near future.

EU policies, international experiences and national strategies of developed countries identify several strategic key issues to be analysed for the purpose of forming cyber security framework at the national level:

1. **Cyber threats:** cyber crime, cyber wars and cyber terrorism. Cyber threats target the infrastructure, individuals, businesses and governments, both nationally and internationally. Critical infrastructure servers and controllers that are connected to the network are vulnerable to attacks which can result in disruption of services and remote takeover. The development of information and communication technologies placed many pieces of information about individuals on the Internet, which left them exposed and vulnerable. Enterprises, especially small and medium ones, increasingly base their business on technology, and new approaches and models. Governments turned to new paradigms, authorisations and types of functioning, diplomacy, democracy, defence, and protection. At the centre of everything is trust which is compromised by each threat. The effects of the attack can have serious impact on society, national and international community, and the costs and weight of consequences increase through time unless there is a quick response system. The rate of new technologies and crime development requires continuous improvement of the crime-fighting system, knowledge and levels of cooperation. International cooperation through existing mechanisms, such as the Council of Europe Convention on Cybercrime, Europol and Interpol, is still facing obstacles due to incompatible policies and bureaucracy, and lack of capacities at national levels. Cyber attacks will be increasingly used in contemporary hybrid warfare and conflicts, a fact confirmed by the *Munich Security Report 2015* (Munich Security Report, 2013). At the same time, the necessary knowledge and resources the attackers are investing are minimal, the effects are great and the risk is mainly small.
2. **Protection:** technical, organisational, legal, diplomatic, political, and societal measures and mechanisms. Cyber attacks and incidents occur daily and their number grows at an increasing rate. It is imperative to develop an efficient mechanism for effective defence against current and future threats, decision making, and early warning systems. Taken measures can be preventive or reactive, aimed at early threat identification, target “resistance” enhancement (infrastructure, individuals, businesses, governments, international community) and efficient cyber risk reduction. Technical measures are hardware and software solutions meant to provide mainly physical protection (Poonia et

al., 2011). As for the organisational measures, crisis management, cooperation and communication of subjects, development of human resources equipped to perform that, as well as the promotion of all protection measures, are particularly important. Legal measures comprise the appropriate legal mechanisms (national, international, self-regulatory) to protect the data, information and communication technologies, and processes related to it, as well as subjects (Warren, 2011). For the purpose of maintaining cyber space security, it is necessary to set a strong flexible legal and institutional framework, but the cooperation based on mutual trust and sharing of common resources is just as important since the legal and institutional framework makes no sense without it. Due to the geo-strategic importance of the Internet, important new questions have been included in diplomatic agenda, such as: digital policies synchronisation on national, regional and global level;, critical resource and standard management; maintaining Internet security and openness; protection of the public and citizens" interest; protection of personal and national data, human rights and freedoms; children and marginalised groups rights and safety; cooperation among stakeholders through a comprehensive multipartner model; institutional capacity building, etc. Political and societal measures comprise measures to protect the society from unauthorised use and abuse of data, information and communication technologies, and infrastructure. The aim is to eliminate and reduce the cause of system "vulnerability" that could affect the society as a whole, the state, and/or individuals. These measures are realised through outlining protection and security policy, as well as development plan and programmes, both nationally and internationally (ENISA, 2013).

3. **Cyber security:** priorities, principles, institutionalisation, cyber security management, capacity-building with ***C**omputer **S**ecurity **I**ncident **R**esponse **T**eams* (***CSIRT**s*), national and international cooperation in cyber space – cyber peace, peaceful coexistence, coherency, climate of trust, mutual cooperation, collaboration (Christou, 2014). Regarding EU Cyber Security Strategy and *International Code of Conduct for Information Security* of General Assembly UN, as well as national needs and documents in the development of the Information society, special attention is given to the global culture of cyber security in Serbia. Currently, a public hearing is being held on the proposed Law on Information Safety which should institutionally establish a national CSIRT[1] (Proposal, 2013) and the jurisdiction should be assigned to the Regulatory Agency for Electronic Communications and Postal Services (RATEL). The primary mission of a CSIRT is to help other organisations handle incidents occurring in computer networks, as well as provide a wider set of services (Munich Security Report, 2015). National CSIRT will be responsible for coordination of individual CSIRTs in Serbia (Ministry of the Interior – MoI, Ministry of Foreign Affairs – MFA, Administration for Joint Services of the Republic Bodies – UZZPRO) with other relevant institutions: Ministry of Trade, Tourism and Telecommunications (MTTT), Special Prosecutor"s Office for High-Tech Crime (PTVTK), and private sector CSIRTs (Serbian National Internet Domain Registry – RNIDS, Internet Service Providers – ISPs, mobile telephone operators, etc.). In order to enable such networking, it is necessary to develop tools and techniques which will provide standardised and efficient communication. By defining/forming this mechanism, a framework would be set for undertaking long-term activities which would connect all stakeholders, enable national critical infrastructure protection and joining international 24/7 network (Javaid, 2013).

2. OBJECTIVES OF THE PROJECT

The main goal of this project is to improve information processing, information analysis and information-sharing infrastructure so as to allow for the exchange of sensitive and confidential data among the competent authorities. Other goals that will be achieved in this project: open, reliable and free digital society; safe and reliable business environment; safety of citizens; the development of economy and critical infrastructure; fight against crime and improved defence; creating of safe environment for institutions, economy and citizens; greater use of modern technologies; raising end-user awareness. That will be achieved by effective decision making, early warning systems and cyber security management - ***System** for **C**oordinate and **E**fficient **R**esponse to **C**yber **I**ncidents* (***CERCI System***)[2].

The objective of the project is to explore how the responsiveness of individual CSIRTs supported by CERCI System can be radically enhanced by advanced technology, exploiting, in an innovative way, sharing of information among different national authorities and sector-specific CSIRTs in private sector.

---

1 That coordinates and facilitates the handling of incidents for a particular country

2 Proposal of *Directive of the European Parliament and of the Council concerning measures to ensure a high common level of network and information security across the Union* specifies the necessity to improve cooperation on network and information system security at EU level with a view to counter cross-border incidents and threats effectively. http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52013PC0048

That will be achieved through the development of two key services in **CERCI System**:

(a) service for efficient management of collaborative CSIRTs activities and access to and supply of shared content (event, threat, incident, etc.) - **Security Information and Event Management (SIEM) Services** and
(b) improved information processing, data analytics and visualisation - **Cyber Incident Data Analytics Tool (CIDAT)**.

Numerous international experiences show that the practical and operational cooperation platform, such as CERT (Computer Emergency Response Team) or CSIRT, is essential as a hub for collaborative multipartner model. Information about worldwide risks, omissions and incidents are distributed and available in many global analytic sources and shared among national CSIRTs. It is also of great importance for Serbia to form such a national operational body as soon as possible, so as to be able to access the networks of CSIRTs, exchange information about risks, process information about reported and identified incidents in Serbia, prepare reports on the state of the Serbian cyber space and regularly act to eliminate incidents in the country (Urosevic et al., 2014).

It is also important to emphasise the necessity of cooperation between CSIRTs and European institutions for cyber security. The expected adoption of *Directive of the European Parliament and of the Council concerning measures to ensure a high common level of network and information security across the Union* will demand that the member states develop a network, information security strategy and a national cooperation plan, as well as define competent authorities and establish CSIRTs. Due to the delay in adoption of this Directive, building of a secure infrastructure has not begun yet.

National centres and teams for combating cyber crime have been formed by most European countries. Apart from Bosnia and Herzegovina and the Republic of Macedonia, the Republic of Serbia is the only country in the Balkans that does not have an established centre of this type. This provides the opportunity to review experiences and shortcomings of national solutions in the EU countries and establish state-of-the-art cyber security solutions.

The process of harmonisation of the legal framework of the Republic of Serbia with the EU acquis within the Negotiation Chapter 10 - Information Society and Media, encompasses EU documents that refer to cyber security and impose an obligation of forming an adequate national institution for combating cyber incidents, i.e. cyber crime. For years, all relevant Serbian institutions have been exchanging experiences through trainings, instructions or study visits with European professional and government bodies. Considering the fact that the realisation of this project primarily requires connecting all national stakeholders, a decision has been made to develop solutions (CERCI System) in-house in the first phase by the representatives of executive authority, academic and professional Serbian community. This project would meet some specific requests stated in the proposed Directive.

In order to achieve high level of cyber space safety, all potential weak links must be secured, including military and civilian sectors, government authorities, critical infrastructure, organisations, small and medium-sized enterprises and the end-users themselves (Haller et al., 2011). CERCI System actively includes all societal sectors as partners into national cyber security framework and utilises the existing resources in those sectors.

3. CONCEPT AND APPROACH

To explore validity of the stated viewpoints, CERCI System will address the government and private sector as the most critical. The project viewpoints and new services will be, therefore, validated within Business Cases all involving cyber security information transfer and objectives harmonisation between different organisations.

Current situation analysis will be conducted based on the data obtained by various methods and using the experiences (European Police Office, 2014) from *the **I**nternet **O**rganised **C**rime **T**hreat **A**ssessment* (iOCTA) within EMPACT (*The **E**uropean **M**ultidisciplinary **P**latform **A**gainst **C**riminal **T**hreats),* and also *SOCTA (**S**erious and **O**rganized **C**rime **T**hreat **A**ssessments) UNODC (**U**nited **N**ations **O**ffice on **D**rugs and **C**rime),* as well as other methods used for data collection and environmental scanning, such as *PESTEL* (***P**olitical, **E**conomic, **S**ocial, **T**echnological, **E**nvironmental and **L**egislation*), i.e. *PESTLE* (***P**olitical, **E**conomic, **S**ocial, **T**echnological, **L**egislation and **E**nvironmental*) that affect crime and the application of law[3].

[3] UNODC, *Guidance on the preparation and use of serious and organized crime threat assessments*, http://www.unodc.org/documents/afghanistan/Organized_Crime/SOCTA_Manual_2010.pdf

Among numerous services (see Table 1) needed to support collaborative SCIRT activities in a CERCI System, this project has selected the most critical ones to explore and demonstrate the validity of the stated viewpoints. The services will be highly flexible and scalable, easy to integrate within different digital environments of different actors within a CERCI System. The services will be applicable in a combination with existing Portfolio Software Solutions (***PSS***) and Cyber Security Management Systems (***CSMS***) to allow easy usage of the results in different environments. It is likely that such services will have a high impact on new ways of collaboration between public and private sector. The intention is to develop services to fit the Collaborative Reference Architecture (CRA) relevant for the national or sector-specific Cyber Security Centres or similar organisations. The objective is to allow for an effective combination of these new services with the existing or emerging services for collaborative work, which in turn will allow better integration of CSIRT activities with the everyday work.

The main issue is to enable an effective measurement of the synergistic effects between the services from the perspective of CERCI System responsiveness. As responsiveness is defined through increased motivation to proactively learn and construct cyber security data exchange in CERCI System, the measurement of system functioning as a synergetic system has to be evaluated against specified responsiveness criteria for effective decision making. Since the CERCI System model is quite new, no such criteria for responsiveness have been elaborated so far, but these will be developed as part of the project.

The European Commission[4] has presented the requirements and tasks of a CSIRT.

Table 1*:* CSIRT Services list from CERT/CC[5]

I Reactive Services	II Proactive Services	III Security Quality Management
1. Alerts and Warnings 2. Incident Analysis 3. Incident Response Coordination 4. Vulnerability Analysis 5. Vulnerability Response Coordination	1. Announcements 2. Security Audits or Assessments 3. Security Related Information 4. Dissemination	1. Risk analysis 2. Security Consulting 3. Awareness Building 4. Training

Networking through CERCI System will provide a new concept of early warning systems, effective detection and activity identification, develop mitigation and response strategy, establish trusted communication channels, effect a coordinated response, share data and information about the activity, track and monitor this information to determine trends and long-term remediation strategies, improve coordination and standardise procedures among national or sector-specific Cyber Security Centres.

CERCI System fulfils all the requirements of a CSIRT through: developing an infrastructure for coordinating response, developing a capability to support incident reporting, conducting incident, vulnerability and artifact analysis[6].

These services will include:

I **Security Information and Event Management (SIEM) Services** consisting of:

- Services for **M**anagement of **C**omputer **S**ecurity **I**ncident **R**esponse **T**eam (MCSIRT) that serve to:
  a) identify partners (from public, private and academic sector), include them in collaborative CSIRT activities, in accordance with their responsibilities, within a complex CERCI System environment;
  b) standardise policy and procedures in accordance with the report of European Union Agency for Network and Information Security (ENISA, 2012) on harmonisation in terminology, definitions, validation processes or requirements for National/governmental CSIRTs and standards published by International Organization for Standardization/International Electrotechnical Commission (ENISA, 2006);
  c) support CSIRT"s objectives and different levels of expertise in an organisation, as well as different collaboration patterns that depend on jurisdiction and organisational structure; these will include so-called feedback provision services.
- Discovery/Provision of internal and external expert sources, including accessing, managing and monitoring content available within a CERCI System, to determine trends and patterns in incident activity.

[4] European Commission, 2013 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2013:0048:FIN:EN:PDF

[5] Adapted CSIRT Services list from CERT/CC: http://www.cert.org/csirts/services.html, There are other services not included in the project, which shall be developed within the Centre after the establishment of CERCI System.

[6] ENISA"s recommendations define the activities every SCIRT should fulfil

II Cyber Incident Data Analytics Tool (CIDAT):

- Provision of the most appropriate SIEM path for CSIRT-based software solution, taking into account different models of early warning systems for vulnerability discovery, initial triage, reproducing, evaluation, distribution and notification, using machine learning[7] techniques – **N**eural **N**etworks (NN)[8] – which will be deployed to study the types of incidents, vulnerabilities and weaknesses, the types of attackers, the patterns of incident content, etc.
- Improvement of the decision-making process of teams inside CERCI System using a rule-based system (RBS)[9] and in accordance with different organisation objectives and policy within the SIEM activities.

The analysis of internal complexity of organisations' ICT systems and the external threat environment, institutional and legal framework, roles and purpose of the existing human and technical capacities, services provided by CSIRTs in the Republic of Serbia, as well as comparative analysis of CSIRTs in EU, Serbia and countries in the region, will show best practice of CSIRT functionality and give parameters for the efficient model for coordinate and efficient response to cyber incidents - CERCI System. The testing of the developed System will be performed in a specially defined environment within the academic network of Serbia (which already has academic AMRES - CSIRT). The pilot project will be realised with teams from MoI and RNIDS since these institutions are going to form CSIRTs in the next year. MoI, throughout the implementation of new e-government services, must additionally take care of the security of information systems and data stored in their databases.

RNIDS manages the register of national Internet domains (TLD and IDN) assigned by ICANN, maintains the main DNS server for ccTLD and IDN, manages publicly available WHOIS server for national domains, establishes the principles of operation and procedures for the operation of accredited registrars and is therefore crucial for CERCI System implementation. After the measurement, analysis and improvement of CERCI System, training courses will be organised and realised for the representatives of all institutions" CSIRTs in the project. When the quality assessment is finished, CERCI System will be handed over to RATEL. Gradually, CSIRTs of other institutions will be included, i.e. secure information systems of state administration will be integrated. Centre will provide technical support until the conditions are created for the official institutions to completely take over the CERCI System management. Also, studies will be conducted and training courses will be organised in order to continuously raise police and judicial capacities and give suggestions for legal improvements in cyber security. Alumni group will be formed and occasional meetings will be organised with training course graduates for knowledge innovation. During the project, numerous communication activities will be carried out with the media and other target publics both through Press page on project"s website and other places in coordination with all PR offices within the institutions and organisations that are partners on the project. Centre will regularly follow the latest trends, develop new modules and improve CERCI System in accordance with structural and functional changes.

Therefore, this project intends to simultaneously address two tightly connected critical problems:

- How to provide effective means for collaborative teams within CERCI System, with geographically distributed partners (Diplo, 2015)? How to improve knowledge and experience sharing and the opportunity to exchange not only technical solutions and procedures but also actual software (Cichonski et al., 2012)? Although all stakeholders possess different levels of expertise, CIDAT will form a common-knowledge database for all actors and therefore improve the decision making process and efficiency.

---

[7] Machine learning has evolved from the study of pattern recognition and computational learning theory in artificial intelligence. It explores the construction and study of algorithms that can learn from and make predictions on data. Such algorithms operate by building a model from example inputs in order to make data-driven predictions or decisions, rather than following strictly static program instructions.

[8] Neural network (NN) is a machine learning technique, inspired by the way the human brain works. It consists of interconnected processing units - artificial neurons - that are able to learn from data by using specialised learning algorithms. NNs are typically used for resolving ill-defined problems, when the underlying model is unknown, when the data are error prone, and/or when generalisation ability is required.

[9] A rule-based system is a program that uses rules to do some specific task: derive an expert-like conclusion, make a recommendation, constrain a business process, implement a policy, etc. Nowadays, RBSs are widespread and can be found under different names: expert systems, automated monitoring systems, business rule management systems, business rule engines, etc. Rules in RBSs are simple IF-THEN statements that capture domain heuristics. These can be regular rules (e.g., "IF the tire is flat THEN first try to re-inflate it") but, if the knowledge is uncertain or fuzzy, uncertain rules (with numeric certainty factors used in a rule"s IF and/or THEN part) or fuzzy rules (i.e., rules with fuzzy expressions such as "IF the service is good THEN the tip is large") can be employed. Conclusions are made by using inference algorithms which associate facts with rules to derive new facts. Finally, RBSs can have explanation facilities that explain "HOW" the RBS has reached its conclusions, "WHY" it has asked some question or what problem-solving strategy ("STRATEGY") has been employed. The goal is to give users an insight into the reasoning process, thus alleviating their confidence in the system"s findings.

- How to harmonise different ways of recognising incidents, classification, prioritisation, marking and handling threats by employees in CSIRTs? Deviation can be in scope (for example, cooperation with significantly more other groups or groups with special requirements such as law enforcement, government, or Intelligence agencies), technical details (for example, new technology), or novelty (for example, a new type of incident). The project responds to this question by developing a CIDAT approach between CSIRTs and CERCI System. To be efficient and provide adequate response to incidents, this approach should be implemented by deploying a regulation mechanism which facilitates harmonisation and establishment of a common ground upon different CSIRTs. The project suggests that such an approach can be considerably enhanced by effectively exploiting the experience between CSIRTs and CIDAT. Exchanging these data in a secure way, reacting and providing information improve the quality of the incident handling process (ENISA, 2006).

In order to exploit the synergy between collaborative SIEM and comply with public and private objectives within dynamic, flexible CERCI Systems, efficient technology for early warning systems and cyber security management in CERCI System is essential. The project, therefore, focuses on these two problems, aiming to provide organisational and technical solutions for effective defence against current and future threats, which requires the addition of a balancing, outward focused approach on understanding the adversary"s behaviour, capability, and intent.

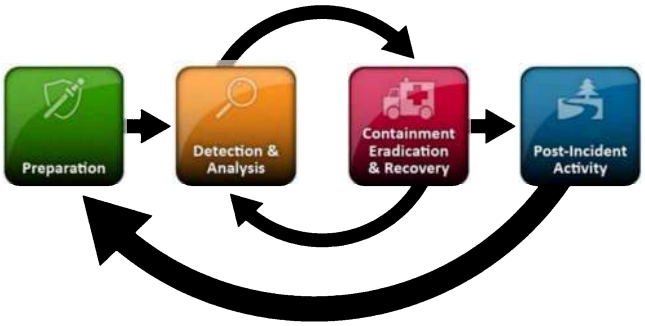


Figure 1: Incident response cycle

According to some international experiences, such as the recommendations of the American National Institute of Standards and Technology, the incident response cycle comprises four phases: Preparation; Detection and Analysis (reports, assessments, classification and triage – rejection, redirection or processing); Containment, Eradication and Recovery (inquiry, collecting data, incident response recommendations, providing assistance); Post-Incident Recovery, as shown in Figure 1[10].

Theoretical models of CSIRTs consider four core principles for effective CSIRTs: technical excellence, trust, resource efficiency and cooperation (Haller et al, 2011). However, the lack of automated intelligent platforms for activities and processes in CSIRTs is evident, and the means of achieving responsiveness are still in the phase of intensive development and investigation. By investigating the assumed increase of CERCI System"s responsiveness resulting from the synergy of the various services, the project will actually explore how technology creates conditions for effective CERCI System. It will also show the role of different services in practical application of this model.

This concept of CERCI System requires technologies to support sharing, harmonisation, building, and dissemination of information/warnings among law enforcement, government, or Intelligence agencies and universities, and effective combination of content and organisational information exchange systems (at both universities and organisations). The management of content and cyber security information exchange has a key role for both collaborative SIEM and harmonisation of public and private objectives. Thus the experiences between different CSIRTs must be fully exploited for the benefit of CERCI System. It is important to develop cyber security risk management tools and techniques within a CERCI System and use data from as many CSIRTs as possible.

While many CSIRTs effectively support collaboration, the existing solutions mainly do not meet specific needs regarding different collaboration patterns demanded in industry, often due to, e.g. „lack of people and resources" for processing all incidents (Chen et al., 2014). The CERCI System project will explore, for the first time, how collaborative CSIRTs can be improved by exploiting synergy of these two services (SIEM and CIDAT Services).

Such cyber incident knowledge and experience “chunking” model is typically implemented as an overlay model, a stereotype model, or a combination of the two. CERCI System is not only a coordinated and synergy model, but also a knowledge-sharing model (as shown in Figure 2) since it is based on knowledge and experience of all CSIRTs so that every individual CSIRT will be able to learn what any other CSIRT already knows, if it is related to protection from cyber attacks, incidents and threats.

[10] NIST Special Publication 800-61 Revision 2, Computer Security Incident Handling Guide, U.S. Department of Commerce - National Institute of Standards and Technology (August 2012) http://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-61r2.pdf

Within CERCI System, an individual CSIRT can use CIDAT for information exchange in a standardised way by using different applications. CIDAT primarily includes sharing of reports which will be precisely formatted, concise, transparent, and with data visualisation, in order to create a basis for faster and easier decision-making. Thusly built trust among CSIRTs can even lead to cooperation on levels not only related to cyber threats and incidents, which is implied by nature.

An innovative approach of CERCI System in this project will cover two issues:

a) how to use independent knowledge and experience of individual CSIRTs in order to find the most effective model for creating „joint knowledge and experience“;
b) how to most effectively adjust that joint knowledge to best match the needs of specific cyber security requirements.

Part of the CERCI System that relates to joint knowledge-sharing does not imply joint training courses and seminars but synergy of knowledge-building and duty-performing with a common goal to create a safer cyber space and protect users.

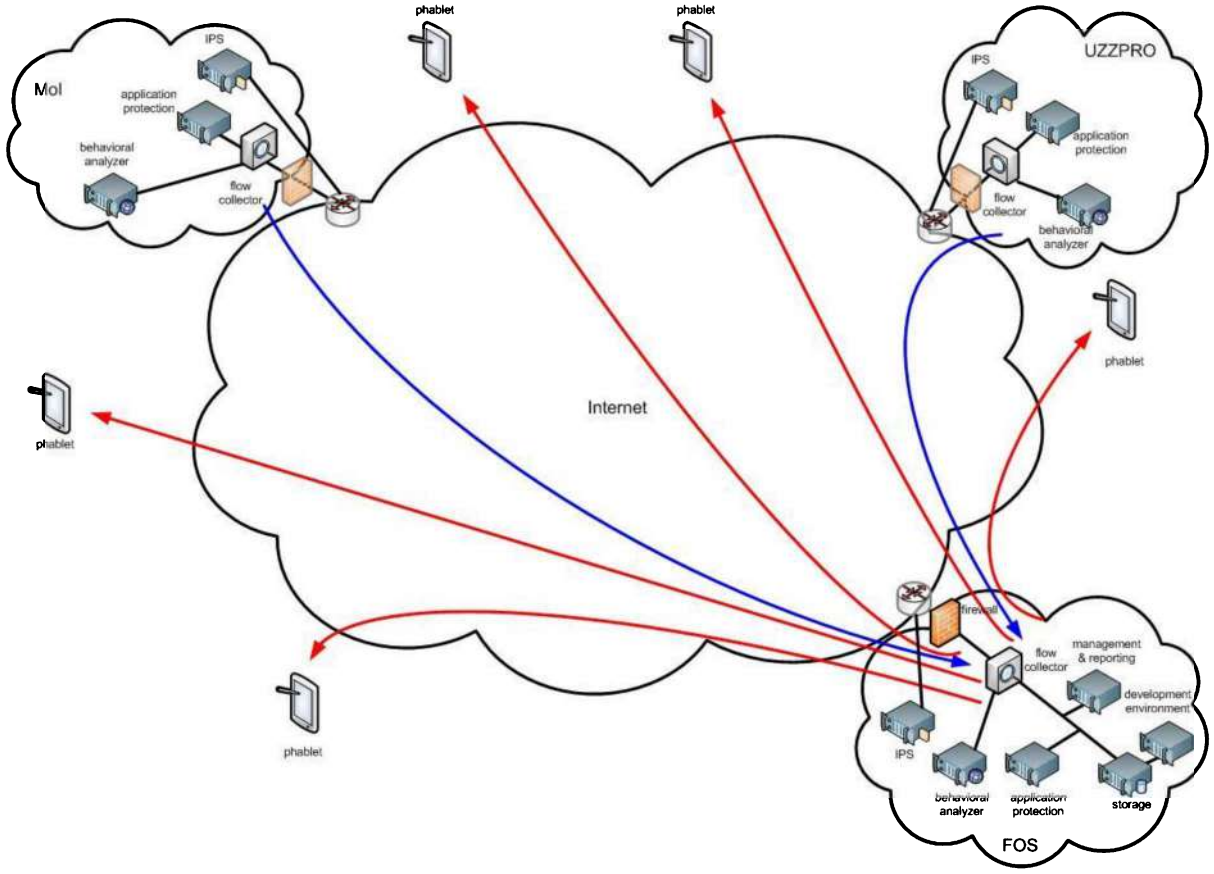


Figure 2: Scheme of CERCI System

The key part of CIDAT is quick identification and very quick classification of detected incidents using NN – it recognises typical patterns of incidents, classifies new threats according to the patterns it has learned. Software will be used by all parties according to a standardised procedure, but not all parties will be given the same authorisation, i.e. not all parties will be using the software for the same purpose, but in accordance with their individual competency, needs and interests.

4. CONCLUSION

The protection of vital societal functions through cooperation between official institutions, corporate, NGO and academic sector, and citizens will be implemented through CERCI System. Multipartner model is essential for the gathering of distributed information about safety risks, coordinated prevention and incident response, awareness and institutional capacities building, and the use of international contacts network for cooperation and support. This type of model, primarily a public–private partnership, is based on trust and cooperation, common interest and needs, all within the frame of a legally regulated system and the existing

jurisdiction of state authorities. For RATEL, the national contact point which integrates different organisations in combating cyber threats through CERCI System, communication with similar centres worldwide will be facilitated, as well as operational activities in case of incidents.

Through CERCI System, mechanisms and procedures will be developed for risk management, early warning systems and malware analysis (viruses, worms, and Trojan horse programs) – SIEM Service will harmonise and standardise communication procedures between individual SCIRTs and public and private sector (ISPs, hardware and software manufacturers). Also, data analytics tools and techniques (CIDAT) will be developed and they will provide, in an innovative way, automated and high-performance classification of events, threats, and risk data to provide strong security intelligence. That will create the basis for effective decision-making, faster response to incidents and extensible compliance reporting.

REFERENCES

Chen,T.R , Shore,D. B. Zaccaro, S.J., Dalal, R.S., Tetrick, L.E., Gorab, K., (2014), An Organizational Psychology Perspective to Examining Computer Security Incident Response Teams, IEEE Security & Privacy, vol.12, no. 5, 61-67. doi:10.1109/MSP.2014.85

Christou, G., (2014), The EU"s Approach to Cyber Security, http://privatewww.essex.ac.uk/~susyd/EUSC/documents/EUSC%20Cyber%20Security%20EU%20Christou.pdf

Cichonski, P., Millar, T., Grance, T., Scarfone, K., (2012), Security Incident Handling Guidenational, Institute for Standard and Technology U.S. Departmant of Commerce, http://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-61r2.pdf

Diplo (2015), Ka nacionalnom okviru za sajber-bezbednost u Srbiji: izgradnja višepartnerske platforme, http://issuu.com/diplo/docs/ka_nacionalnom_okviru_za_sajber-bez

ENISA, CERT cooperation and its further facilitation by relevant stakeholders (2006), http://www.enisa.europa.eu/activities/cert/background/coop/files/cert-cooperation-and-its-further-facilitation-by-relevant-stakeholders

ENISA, Good practice guides for CERTs in addressing legal and operational NIS aspects of cybercrime, (2012), http://www.enisa.europa.eu/activities/cert/support/fight-against-cybercrime/good-practice-guide-for-addressing-network-and-information-security-aspects-of-cybercrime/at_download/fullReport

ENISA, Good practice guide for CERTs in the area of Industrial Control Systems - Computer Emergency Response Capabilities considerations for ICS, (2013), http://www.enisa.europa.eu/activities/cert/support/baseline-capabilities/ics-cerc/good-practice-guide-for-certs-in-the- area-of-industrial-control-systems/at_download/fullReport

European Commission, Proposal of Directive of the European Parliament and of the Council concerning measures to ensure a high common level of network and measures to ensure a high common level of network and information security across the Union,(2013), http://ec.europa.eu/digital-agenda/en/news/eu-cybersecurity-plan-protect-open-internet-and-online-freedom-and-opportunity-cyber-security

European Police Office, Internet Organised Crime Threat Assessment (iOCTA) 2014, www.europol.europa.eu

Haller, J. S. , Merrell,A., Butkovic,M.J., Willke, B.J., *Best Practices for National Cyber Security : Building a National Computer Security Incident Management Capability,* (2011), http://www.sei.cmu.edu/reports/11tr015.pdf

Munich Security Report (2015), Collapsing Order Reductant Guardians, http://www.eventanizer.com/MSC2015/MunichSecurityReport2015.pdf

NIST Special Publication 800-61 Revision 2, Computer Security Incident Handling Guide, U.S. Department of Commerce (August 2012) National Institute of Standards and Technology, http://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-61r2.pdf

Poonia A.S., Dangayach G.S., Dr. Bhardwaj A., (2011), Technical management issues for resolving the cyber crime, 3rd International Conference on Information and Financial Engineering, IPEDR vol.12, http://www.ipedr.com/vol12/24-C026.pdf

Urosevic V (Ed.), (2014), Cybercrime and links to irregular migrations and human trafficking, Publisher: Ministry of Interior of the Republic of Serbia, Belgrade

Warren E., (2011), Legal, Ethical and Professional Issues in Information Security, http://www.cengage.com/resource_uploads/downloads/1111138214_259148.pdf

RESEARCH IN THE FUNCTION OF IMPROVEMENT OF PUBLIC PROCUREMENT LAW

Jovanka Vukmirović*[1], Predrag Jovanović[1], Dragan Vukmirović[1]
[1]Faculty of Organizational Sciences University of Belgrade
*Corresponding author, e-mail:vukmirovic.jovanka@fon.bg.ac.rs

Abstract: *Key findings of researching the positions of enterprises concerning public procurement, conducted in June 2015, were endorsed in the course of drafting the Amendments to the PPL, and that relevant measures have yielded the first positive results in the last quarter of 2015. as registered in the quarterly reports that contracted authorities are required to submit to the Public Procurement Office, on the basis of which this Office compiles its annual reports on public procurements. This case may serve as a model for all future amendments of the laws in Serbia in the sense that sound researches and analyses should precede regulatory changes. Findings of a comprehensive research of the effects of a law implementation coming from practitioners are irreplaceable inputs to the process of designing measures for upgrading the regulation.*

Keywords*: public procurement, amendments and supplements, research of attitudes of participants*

1. INTRODUCTION – RESEARCHINGTHE FUNCTION OF REDUCING UNCERTAINTY IN THE DECISION MAKING PROCESS

The public opinion poll and market research in the broadest context are the collection, analysis and control, or respectively the data exchange from the environment, under strictly controlled methodological rules (Vukmirović & Vukmirović, 2016). The result which follows represent information that is the basis for making responsible operational, tactical and strategic decisions. Research in the function of Management is a direct support for decision-making and information obtained in the process of research are aimed to decrease uncertainty in decision-making (Kochenderfer, 2015).

Decision making without relying on the information seconded from a research source represents a high-risk way of management and thus, in contemporary practice almost ceased to exist (Lacobucci & Churchill, 2015). Selection, processing and distribution of data is carried out through the use of modern information and communication technologies (ICT), all in the purpose of converting those data into knowledge starting from lower to higher decision making levels. Therefore, a user interface and the quality (accuracy, timeliness and coverage) of available information are very important for managers. Wrong decisions can still be made, but the probability is drastically reduced if decision makers have relevant information that serve as a basis for critical judgment.

2. THE PUBLIC PROCUREMENT LAW

Law on Public Procurement was adopted in 2008 after six years of applying the first Public Procurement Law ("Official Gazette of Republic of Serbia", No. 39/02, 43/03, 55/04 and 101/05), and after the adoption of the EU directives in this area (Directive 2004/18 / EC, Directive 2004/17 / EC, Directive 2007/66 / EC). According to the opinion the proposers, the law did not only fail to improve the public procurement system, in some segments it also represented a step backwards. In December 2012, third Law on Public Procurement was adopted ("Official Gazette of Republic of Serbia", no. 124/2012). The Law from 2012 was a very significant step forward when considering conditions for efficient use of public funds, in prevention of corruption and conflicts of interest, and it also was important for the establishment of a single market in public procurement and ensuring competition. The key innovations of this Law were:

- alignment with the European Union;
- more complete and simpler definition of the contracting authority;
- a clearer determination of the subject of public works contracts;
- reduce the number exemptions from the application of the law;
- tightening the conditions for the application of exemptions;
- a mechanism control prior of application of negotiated procedures that are commonly used;
- mechanisms for preventing conflicts of interest and corruption in public procurements;
- the partial centralization of public procurement;

- encouragement and in certain conditions obligation to perform electronic procurement;
- introduction of a new procedure - the competitive dialogue and regulation of two new forms of existing procedures - dynamic system of procurement and a framework agreement;
- Public procurement of small value is regulated in a way that enables process transparency and competition;
- planned mandatory publication of tender documentation, efficient publication and prescribed mandatory content of ads on public procurement;
- introduced environmental standards, and standards of energy efficiency as potential parts of the technical specifications;
- specifies the method of calculating appraised value;
- clearly stipulated manner in the decision to award the contract, procedures and deadlines for the conclusion of the contract;
- clearly and restrictively prescribed the possibility of changing the contract;
- for the first time regulated procurement in the defense and security domain;
- increased the responsibilities and powers Public Procurement Administration;
- changed the composition and operation of the Republic Commission for protection of rights where the Commission granted new powers, such as fines for non-compliance procedure itself to protect rights and the non-implementation of decisions, control of implementation of decisions of the Commission, annulment of the contract, conducting misdemeanor procedure at first instance and the submission of proposal for dismissal;
- system of protecting the rights has been made more efficient on the one hand by simplifying the procedure, and on the other through the introduction of new features such as proposing and imposition of temporary injunctions;
- misdemeanors are provided for all serious violations of laws and criminal sanctions are tightened with on the one hand, and on the other are ranked according to the severity of the offenses;
- statute of limitations for the offenses has been increased to three years;
- it is envisaged for the final decisions issued in misdemeanor proceedings to become published publicly

3. PREPARATIONS FOR THE ADOPTION OF AMENDMENTS AND SUPPLEMENTS TO THE LAW ON PUBLIC PROCUREMENT

Given that the State today represents the largest employer in Serbia, the Provisions of the Public Procurement Law were and remain the theme of national importance, and therefore are subject to permanent professional and media analysis, criticism and suggestions. On the eve of all stakeholders in the public procurement procedures, first of all the Bidders and Contracting authorities, the Public Procurement Office in cooperation with the of UNDP and support of the Kingdom of Sweden, two years after the application of the Law from 2012 has joined the preparations for the audit of the Law on PPL.

The first step was to identify major weaknesses in Public Procurement Law (PPL) implementation during past two years. In direct communications with their clients (contracting authorities and bidders), the Public Procurement Office (PPO) detected broader fields where improvements were needed: reducing unnecessary administrative burden on bidders, particularly small and medium sized enterprises (SMEs), increasing efficiency of public procurement procedure and reducing the rate of tenders annulled due to purely formal reasons (Cook & Semple, 2015). However, more detailed and comprehensive research was required in order to detect concrete obstacles and problems that have to be addressed in the planned amendments of the PPL. For that reason.

The Public Procurement Office in cooperation with the of UNDP and support of the Kingdom of Sweden has initiated an extensive research public opinion polls and market research, which included relevant categories of participants (bidders) in public procurement procedures.

The main aim of the research referred to perception of attitudes and value judgments of the participants (bidders) in the public procurement procedures and of their positive and negative experiences, as well as their attitudes about the Law on Public Procurement. In addition to the above mentioned objectives, the research had some specific objectives, such as:

1. Did Law from 2012 contributed the fight against corruption?
2. To what extent did regulatory and control measures of the Law of 2012, whose main objective was to Suppression of Corruption, hinder prolong and impede the public procurement procedures?
3. To what extent did additional administrative measures increase the costs and prolong the procedure, at the expense of suppliers as well as at the expense of clients and taxpayers?
4. To what extent is the complexity of the procedures, and the presence of corruption discouraged enterprises from participating in public procurement procedures?

5. To what extent did legal solutions increase overall transparency and how the establishment of the Public Procurement Portal contributed to this?
6. Should the Public Procurement Law regulate the procedure of public procurement so that it becomes a fast, efficient and easy to implement, and whether the Criminal Code and the Law on Misdemeanors should deal with issues of corruption and punishment?

4. METHODOLOGICAL FRAMEWORK FOR THE RESEARCH OF ATTITUDES OF PARTICIPANTS (BIDDERS) IN THE PUBLIC PROCUREMENT PROCEDURES

In Serbia, at the end of 2014, there were 331.059 of business entities operating under the status of "active." Of the total number registered, there were 115.692 active Companies, while the number of registered Entrepreneurs amounted to 215,367. Sample comprises only of active companies (excluding entrepreneurs). The study used a stratified, two-stage pattern. The strata consist form small and medium-sized enterprises (SMEs), up to 10 employees and of "large enterprises" - with more than 10 employees. Units of the first stage consisted of the active companies, while in the second stage it was selected according to business of companies (positive, negative, or “zero") in the previous year (2013).

Sample framework was the Register of companies of the Agency for Business Registers (www.apr.gov.rs). Size of the sample amounted to 1,009 enterprises and companies (companies). The sample is representative at the level of small and medium-sized enterprises up to 10 employees and companies with more than 10 employees. The target group of respondents in companies were owners / directors, then the middle management level (familiar and have a personal experience with the participation of enterprises in public procurement) as well as employees who are engaged in public procurement (searching the portal, documentation preparation, etc.). All the participants had Higher education. Data were collected by field survey in June 2015. Selection of companies was performed by software, based on a table of random numbers (Thompson, 2012). Supervisors urged companies and by telephone interview scheduling, while the interviewers were given information when and where to go and who in the enterprise / company to talk to.

5. THE RESULTS OF RESEARCH ON THE ATTITUDES OF PARTICIPANTS (BIDDERS) IN PUBLIC PROCUREMENT

Nearly three-quarters of surveyed companies (72%) participated in 2014 and 2015 in public procurement, which means that the survey gathered views not only of those who participate, but also of those which do not participate, which could indicate the reasons for non-participation. The bidders which participated in public procurement procedures were asked to say how many times they participated in during 2014 and 2015 and how many job did they get. Most of the companies that participated were positive financial (41 times on average), while businesses engaged "zero" or negative participated two and a half times less: 18, or 16 times.

From 38 participations in tenders in average for all surveyed companies, 13 cases were successful, which means that the success rate was 34%. Broken down by company size, micro enterprises (up to 9 employees), which are the most numerous in Serbia, were the rarest to participate in the tenders, while the number of occurrence (as well as the number of won tenders) increases with company size.

When asked what the first thought when it says "public procurement", the three most common associations were: tenders, state, public companies (32%), the possibility of getting a job (11.4%) and a bunch of papers and documents (10.7%).As the main source of information on public procurement, companies have stated Portal of public procurement. Reviews of the Portal in terms of its usefulness, transparency, inclusiveness and transparency were mostly good.

Of the four properties that have been evaluated a minimum was given the positive assessment of transparency (67% of best estimate). In two thirds of cases (65%), bidders do not believe that the public procurement procedures are „fixed" in advance. Tenders that are "fixed" in advance are recognized mostly on the basis of too demanding technical specifications and tight deadlines (57%) or when the price is much lower than the real (11%). Almost a third of respondents (32%) "know" that everything is pre-arranged.

Most providers (70%) believe that the law is "on their side". When this is added the fact that the Republic Commission for Protection of the rights in Public Procurement, in almost two thirds of the cases ruled in favor of the bidder, i.e. adopt their complaints, it seems that the legal solutions and institutions efficiently protected the rights of bidders. Third of bidder who were surveyed said that they use available opportunities to protect their rights so they complained to the Commission for protection of rights in public procurement procedures.

There is a significant difference in the number of complaints from the smallest (micro) company and the largest, more than 100 employees: micro-enterprises have complained, on average, in 23% of cases, a large almost twice as many (43%).

A similar situation is bound to pointing out the omissions of contracting authorities in the tender documentation which, on average, was 42%: the lowest enterprises indicated to the contracting authorities irregularities in the tender documentation in 30% of cases, and large companies in nearly twice as many cases (53.idders have pointed out that they had the great gain of the use of the Registry of the bidders which frees them to collect evidence for each procedure in order to fulfill four conditions required for participating in procedures. It is enough to put them once in the Registry and enroll. 71% of them are enrolled in the Registry which clearly demonstrates the utility of the Register for bidders, particularly in the sense that they reduce wasted time and money. When asked how much it costs them participate in the procurement process, bidders are given the following responses.

In most cases (45%) the cost of public procurement procedure ranged between 10 and 50,000 dinars, while in 42% of cases were less than 10,000 dinars. In proceedings with the lowest cost (5,000 pounds) has the smallest companies (up to 19 employees), while larger companies were more involved in tenders with higher costs. That indicates that the assessment of the amount of the costs for the participation is one of the factors on which the tenderer assesses whether to participate in the proceedings or not. Another factor is assessment of the potential cost effectiveness of the transaction. Reducing the cost of participation would lead to greater participation of companies, especially smaller ones, so that this factor must be taken into account in the preparation of bidding documents, all in order to encourage the participation of small and medium enterprises and strengthening competition in public procurement. Another important factor that the bidders pointed attention, like the one that reduces the competition is agreement two or more bidders to "dictate the rules" and thus virtually excludes other bidders. In 30% of cases, respondents have reported that bidders have met with such onset.

When asked about the negative experiences with contracting authorities most common was delay in the payment of contractual obligations by contracting authorities in 40% of cases. This is a serious problem, especially for smaller companies, which usually borrow from banks to acquiring the necessary raw material. The delay in the payment of the contracting authority leads bidder in the situation that it must repay the loan from its own resources, which are usually very scarce.

In addition to the problem of delay in payment, the bidders pointed out as a problem using criteria of the lowest price (20%) and unrealistically short deadlines to perform the services (14%). Asked whether is it necessary to have more active involvement of the police and judicial authorities in order to combat abuse and corruption, most respondents (83%) gave an affirmative response.

Third of suppliers have a good or very good knowledge of the Law on Public Procurement (35%), while a somewhat smaller number considered their knowledge of the Law as average (31%). Finally, the general assessment is that bidders have a neutral or positive attitude towards public procurement (total 63%), with 48% neutral and 15% positive. 35% of them have a negative attitude, while others did not declare themselves.

6. THE MAIN FINDINGS OF THE SURVEY AND THE GUIDELINES FOR THE REVISION OF THE LAW ON PUBLIC PROCUREMENT IN 2012

The main objective of the amendments to Law were improvements in the planning of public procurement, the conditions, manner and procedure of public procurement. The Law also regulates the centralization of public procurements and determines the method of recording data relevant to a public procurement procedure (Emmett & Wrigh 2012). The law determines the jurisdiction, operation and forms of organization of the Public Procurement Office and the Republic Commission for protection of the rights in public procurement procedures, as well as of ways for protecting the rights in public procurement procedures. Based on the results of research on attitudes and value judgments of participants (bidders) in the public procurement procedures, of their positive and negative experiences as well as of attitudes of the Public Procurement Law, there were presented the following conclusions and guidelines for drafting the new Law on Public Procurement, which entered into force in August 2015.

How to simplify, accelerate and reduce costs when participating in public procurement procedures
Based on collected data, it can be concluded that the central phase - selecting the best offer, well decorated law referred to 2012, noting that improvements are needed in terms of upgrading transparency and search of procurement in Public Procurement Portal, publication of procurement plans and reducing excessive

formalism. At the same time, at the stage of preparation and planning of the public procurement is necessary to improve the lot of the functions in market survey and planning, while at the stage of execution of the contract it is necessary to introduce systematic monitoring and control of the contract conduction.

How to encourage the participation of SMEs in public procurement procedures
Negative experiences in public procurement processes primarily relate to the inability to collect or delays of several months which may take the suppliers into bankruptcy. It is important to devise mechanisms to monitor and sanction non-performance of contractual obligations, i.e. the realization of the agreement, which is an area that is not in the domain of the Public Procurement Law, but Law of contractual relations and other regulations. Given that in many companies' employees do not know enough about the law on public procurement is necessary to give through the Public Procurement Office to give special attention to the training of micro-enterprises, in order to increase their participation. Incentives for participation SMEs in Public Procurement is given special attention in the new EU directives, as well as in the Development Strategy of public procurement in Serbia.

In addition, it is necessary that the Public Procurement further encourages contracting authorities to share the procurement by the parties whenever it is economically justified in order to create an opportunity for greater participation of small and medium-sized enterprises.

How to boost competition
An important prerequisite for competition is to reduce the number of negotiation procedures without prior publication. The Public Procurement Office is estimating the merits of this procedure, pointed out that the requirements of the contracting authorities were established only in a minority of cases which reduced participation of non-competitive procedures with 17% in 2013 to just 5% in 2014 which is the average in EU countries. It may be noted that, in the context of public procurement two key preconditions for strengthening transparency and competition were created:
a) Portal of for public procurement and
b) Limitation of to the representation in a negotiated procedure without a prior notice.

How to prevent corruption
In almost one third of cases (32%), a factor that discouraged bidders from participating in public procurement procedures had not been specific, but this was a perception („it is known, it can be seen, heard"). This points to the fact that the participation of bidders could increase significantly if the contracting authorities have taken measures to increase the credibility of their public procurement in the eyes of suppliers. In order to overcome the problem of "fixed agreement of bidders," it is necessary that the Competition Commission effectively sanction such occurrences.

Market research involves contracting authorities have communicated with potential bidders, which has not been the case in Serbia. The Public Procurement Office should prepare guidelines for contracting authorities on how to communicate with suppliers in order to conduct market research and also how to avoid the risk of undue influence of suppliers.

Criteria of lowest tender price and unrealistic short deadlines for execution of work requires the development of a system of internal control and audit which would include monitoring whether the bidder who offered the lowest got the job only on the basis of price and whether the bidder delivered the ordering party what was agreed in the contract (in terms of quality, quantity and characteristics). Surveyed enterprises indicated that the problem with most contracting authorities is that they do not have these types of controls, allowing the abuse. Therefore, the strengthening of controls at the stage of execution of the contract by the Public Procurement Office and other control authorities and services is very necessary.

Strengthening the role of the police and judiciary
One of the key issues to overcome weaknesses in the public procurement process pointed out by bidders, is to determine to what extent it is possible to eliminate the deficiencies stated by amending the Law on Public Procurement. Disadvantages such as: a) the inadequate definition of the needs of contracting authorities in the tender documents that do not match the offer in the market, in the sense that it is not clear what is wanted from the bidder, b) the lack of discipline in paying bidders and c) control of fulfillment of contractual obligations, are not possible to solve only with the Amendments to Law on public procurement, but it is also necessary to strengthen the mechanisms of checks and balances.

Then, it is necessary to establish a process for monitoring contract execution and to control the public procurement contracting authority. Internal Audit Unit have an important role in this process, or reviews and approvals of the State Audit Institution (SAI) is also of great importance. In the case of suspected corruption in public procurement, regulatory bodies such as the Public Procurement Office, the Commission and SAI

should inform the investigative authorities (police and prosecutors), in order to effectively conduct sanction by using the courts.

It can be concluded that it is important to clearly delineate what should be edited by the Law on Public Procurement- which is the process of selecting the most favorable bid so this happens in a prompt and efficient manner and that the contracting authority gets what they need, under the most favorable terms and in a timely manner. At the same time, sanctions for violations of the law needs to be conducted by specialized and competent institutions on the basis of the regulations under which they work.

In cases where these other institutions do not do their job as expected, the solution should be sought in the direction of taking measures to increase the effectiveness of their work and more efficient sanctioning of irregularities, which is the best barrier and prevention, instead of transferring responsibilities and tasks in the sphere of public procurement, thus burdening and it makes public procurement processes becoming unnecessarily complicated and expensive measured by expenditure of time and money.

7. IMPACT OF THE RESEARCH

The research had a significant impact on amendments of the PPL. Key findings of the research concerning transparency, efficiency and cost-effectiveness of the procedure, together with the administrative burdening of bidders, were acknowledged as vital issues to be resolved by means of amendments to the Public Procurement Law in order to improve the functioning of the public procurement system. Amendments to the PPL were finalized in July 2015 and entered into force on August 6 of the same year.

With a view to upgrading the transparency in public procurement procedures, the relevant recommendation of small and medium enterprises was adopted by means of introducing duty to publish procurement plans, decisions on awarding contracts, and decisions on cancelling the procedures on the Portal. This increased the number of documents to be published on the Portal, thus improving the informing of bidders and making it easier for them to take part in public procurement procedures.

A measure under the Amendments to the PPL intended to increase the efficiency in public procurement procedure, expressed by the decreased length of the procedure, was the introducing of duty to publish decisions on awarding contracts or on cancelling the procedures on the Portal, instead of delivering those by mail. In this way, the deadlines in the procedure are counted from the moment of publishing on the Portal, which significantly affects the shortening of time between the making of relevant decision and concluding the contract. Under the former practice, there were instances where bidders deliberately avoided to receive decision on awarding contract or decision on cancelling the procedure, thus causing substantial and unnecessary prolonging of the procedure. In addition, the statutory deadlines in the procedures got harmonized with the deadlines under the new Directives and, at the same time, shortened in comparison to the previous legal provisions, which has additionally contributed to expediting the public procurement procedures.

The effect achieved in the last quarter of 2015 was that the average duration of an open public procurement procedure (counting from the date of publishing the invitation to bid on the Portal, up to the day of concluding the contract) was reduced to 61 days, as opposed to 77 days it took to complete this procedure in 2014. In low-value public procurements, the length of the procedure was reduced from 37 to 29 days.

The second set of measures designed to increase the efficiency in public procurement procedures was aimed at reducing the number of cancelled procedures. Data from the Annual Report on Public Procurements for 2014 revealed that the most frequent reason for cancelling the procedure was that all received bids were unacceptable. Quite often, bidders would omit to provide one or another evidence out of numerous proofs of fulfilling mandatory and additional eligibility requirements (which they do fulfil), ending up with the bid being rejected on that grounds. The solution introduced by the Amendments to the PPL whereby all bidders only submit a statement declaring they meet mandatory and additional eligibility requirements whereas only the winning bidder is obliged to submit proofs on meeting all eligibility requirements, has significantly reduced the risk of a bid ending up rejected due to a formal oversight on the part of bidders who omitted to provide a certain proof although they do fulfil such requirement.

The next measure, designed to reduce the number of cancelled and repeated procedures, was to allow contracting authorities to award contract to the bidder whose price exceeded the estimated value in all types of procedures, rather than in open procedures only, and this was done by the Amendments to the PPL. Before these Amendments, contracting authorities would, at times, misestimate the value so that, consequently, all submitted bids would exceed the set value. In such cases, pertinent public procurement

procedure had to be repeated (except in the case of an open procedure), even if the new procedure could not be expected to garner the bids within the limits of the estimated value that had not been properly set in the first place. This was particularly the case with low-value procurements, and especially with the ones formed in lots. According to data from the quarterly reports, in 28% of cancelled low-value public procurements in 2015, the reason for cancellation was that the entire received bid had exceeded the estimated value.

It is worth emphasizing that prices offered in all other appropriate bids must be above the estimated value and that this price is a comparable market price, under the general limitation that contracting authority cannot assume an obligation in the amount exceeding the one allocated beforehand under its relevant financial instrument for this particular procurement. In this way, the new legislation created a precondition for decreasing the number of cancelled procedures and for increasing the number of successfully completed public procurement procedures, which resulted in decrease of the share of cancelled procedures in 2015 to 11% from 13% as it stood in 2014.

The key measure aimed at reducing the administrative burden for bidders (which was one of key findings of the research) was the option to prove fulfilment of all eligibility criteria for public procurement procedure (mandatory and additional ones) by means of a statement. The measure relieving the bidders from duty to submit proofs on fulfilment of mandatory and additional eligibility criteria in each individual public procurement procedure has substantially saved bidders time and money in their taking part in public procurement procedures and, thus, stimulated them to submit bids more readily and partake in public procurement procedures more willingly. This in particular refers to small and medium-sized enterprises (with up to 50 employees) which account for the majority of bidders in public procurement procedures, and which comprise ¾ of the total number of respondents in this research.

The reduction of administrative burden for bidders resulted in their greater readiness to take part in public procurement procedures and, consequently, in the strengthening of competition. For example, the average number of bids per concluded contact in 2015. was 2.9, more than in 2014, when it stood at 2.6 bids; this has effectively discontinued the four-year trend of decline in the average number of bids (and of weakening competition), as identified since 2012.

8. CONCLUSION

In June 2015 was conducted a research in the form of an opinion survey among the small and medium enterprises on the topic of public procurement, with a sample of 1009 enterprises, which produced the following findings. Concerning the transparency of public procurement procedures, most respondents underlined the necessity to publish the procurement plans and the estimated procurement values on the Public Procurement Portal.

The second important finding of this research was that enterprises were hesitant to take part in public procurement procedures where their estimates indicated they would have to spend too much time, or where the required “administration” would be too cumbersome. On the same note, the research also revealed general attitude of bidders that “each paper costs”, and their belief that the reduction of administrative costs would produce positive effects on bidder’ participation in public procurement procedures. As the result of a previous substantial administrative burdening, the participation of bidders in public procurement procedures has decreased, so that the average number of bids per concluded contract in 2014 was mere 2.6.

Another finding of the research was the need to improve the efficiency of public procurement procedure. Greater efficiency in public procurement can be achieved by decreasing the length of the procedure, and by reducing the number of cancelled procedures, which then had to be repeated and caused additional spending of time and money both for contracting authorities and bidders participating in such procedures.

One can conclude that the key findings of researching the positions of enterprises concerning public procurement, conducted in June 2015, were endorsed in the course of drafting the Amendments to the PPL, and that relevant measures have yielded the first positive results in the last quarter of 2015 as registered in the quarterly reports that contracted authorities are required to submit to the Public Procurement Office, on the basis of which this Office compiles its annual reports on public procurements.

Efficiency in public procurement procedures aimed at reducing the number of cancelled procedures was increased by provision that all bidders only submit a statement declaring they meet mandatory and additional eligibility requirements whereas only the winning bidder is obliged to submit proofs on meeting all eligibility requirements. In addition, second measure, designed to reduce the number of cancelled and repeated

procedures, was to allow contracting authorities to award contract to the bidder whose price exceeded the estimated value in all types of procedures, rather than in open procedures only.

The key measure aimed at reducing the administrative burden for bidders (which was one of key findings of the research) was the option to prove fulfilment of all eligibility criteria for public procurement procedure (mandatory and additional ones) by means of a statement.

At the end, it could be concluded that this case may serve as a model for all future amendments of the laws in Serbia in the sense that sound researches and analyses should precede regulatory changes. In many cases in past, amendments of the laws were prepared by relatively small groups of experts and clerks while the "voice of the practitioners" was silent. The outcomes were problems in implementation.

This case proved that a comprehensive research of the effects of the Law implementation with focus on weaknesses in practice coming from practitioners provided precious inputs to the process of designing measures for upgrading the regulation. The first results of the amended law implementation proved the approach was proper.

REFERENCE

Cook, M., & Semple, A. (2015). Practical Guide to Public Procurement. *Oxford University Press.*

Department of Management Office of Central Support Services Procurement Division (2013). United Nations Procurement Manual, revision no. 7.

Directive 2007/66/EC of the European Parliament and of the Council of 11 December 2007 amending Council Directives 89/665/EEC and 92/13/EEC with regard to improving the effectiveness of review procedures concerning the award of public contracts

Directive 2009/81/EC of the European Parliament and of the Council of 13 July 2009 on the coordination of procedures for the award of certain works contracts, supply contracts and service contracts by contracting authorities or entities in the fields of defense and security, and amending Directives 2004/17/EC and 2004/18/EC

Directive 2014/23/EU of the European Parliament and of the Council of 26 February 2014 on the award of concession contracts Text with EEA relevance

Directive 2014/24/EU of the European Parliament and of the Council of 26 February 2014 on public procurement and repealing Directive 2004/18/EC

Directive 2014/25/EU of the European Parliament and of the Council of 26 February 2014 on procurement by entities operating in the water, energy, transport and postal services sectors and repealing Directive 2004/17/EC Text with EEA relevance

Emmett, S., & Wrigh, P. (2012). Excellence in Public Sector Procurement: How to control costs and add value. *Liverpool Academic Press.*

European Commission (2013). *Communication from the commission to the European parliament, the council, the European economic and social committee and the committee of the regions end-to-end e-procurement to modernise public administration.*

Kochenderfer, M. (2015). Decision Making Under Uncertainty: Theory and Application. *MIT Lincoln Laboratory Series.*

Lacobucci, D., & Churchill Jr., G. (2015) Marketing Research: Methodological Foundation. *Earlie Lite Books.*

Official Gazette of Republic of Serbia (2008*). Law on Confirmation of the Agreement on Stabilization and Association between European Community and Its Member States and Republic of Serbia*. No. 83/08

Official Gazette of Republic of Serbia (2009). *Law on Administrative Disputes.* No. 111/09

Official Gazette of Republic of Serbia (2012). *Rulebook on the contents of decision on jointly conducting of public procurement procedure.* No. 124/12.

Official Gazette of Republic of Serbia (2013). *Law on Misdemeanours.* No. 65/13

Official Gazette of Republic of Serbia (2015). *Public procurement Law.* No. 124/12, 14/15, 68/15

Official Gazette of the Republic of Serbia (2015). *The Decision on Defining the List of Contracting Authorities for Whose Needs the Administration for Joint Services of the Republic Bodies Conducts Centralized Public Procurements.* No. 12/15.

Official Gazette of the Republic of Serbia (2015). *The Regulation on Contents of Decision on Conducting Public Procurement Procedure by Several Contracting Authorities.* No. 83/15.

Official Gazette of the Republic of Serbia (2015). *The Regulation on Contents of Legal Act Regulating in Detail Public Procurement Procedures within Contracting Authority.* No. 83/15.

Official Gazette of the Republic of Serbia (2015). *The Regulation on Mandatory Elements of Tender Documentation in Public Procurement Procedures and on the Manner of Proving the Fulfilment of Requirements.* No. 86/15.

Official Gazette of the Republic of Serbia (2015). *The Regulation on the Manner and Programme of Professional Training and Manner of Taking Proficiency Exam for Public Procurement Officer*. Nos. 77/14 and 83/15.

Official Gazette of the Republic of Serbia (2015). *The Regulation on the Subject, Requirements, Manner of Planning Centralized Public Procurements and Conducting of Public Procurement Procedures by the Administration for Joint Services of the Republic Bodies as Body in Charge of Centralized Public Procurements*. No. 93/15

Organisation for Economic Co-operation and Development (2014). *Public Procurement for Sustainable and Inclusive Growth.*

Public Procurement Office (2015). *Public Procurement Development Strategy of the Republic of Serbia for the Period 2014 – 2018*

Public Procurement Office (2016). *Annual Report of Public Procurement in Serbia for 2015*.

Thompson, S. (2012). Sampling, *John Wile & Sons*.

Vukmirović, J. & Vukmirović, D. (2016). *Marketing Research*. Belgrade Business School Higher Education Institution for Applied Studies. ISBN: 978-86-7169-518-3

QUALITY MANAGEMENT 1143

PERCEPTION OF BENEFITS - GUIDELINES FOR THE APPLICATION OF ISO 9001:2015 1144
Cice Jelena, Pribićević Ivan, Kočijašević Strahinja

PARADIGM EVOLUTION: FROM LINEARITY TO COMPLEXITY IN THE WORLD OF QUALITY MANAGEMENT 1154
Borisavljević Miloš, Nedeljković Miloš, Đurić Mladen

SOME TERMINOLOGICAL OBSERVATIONS ON ISO 9000 STANDARD SERIES WITH SPECIAL FOCUS ON ISO 9000:2015 1160
Đordan Andrijana, Jakić Gordana, Anđelković Jelena

QUALITY COSTS IN THE MANAGEMENT SYSTEM IN THE FIELD OF HIGHER EDUCATION 1167
Zivkovic Nedeljka

DOCUMENTING PROCESSES: CHALLENGES FOR FIRMS OPERATING IN SERBIA 1176
Momčilović Marina, Stefanović Ivan

QUALITY MANAGEMENT AND INFORMATION: FROM STAKEHOLDERS REPORTING TO MEDIA PIONEERING QUALITY 1183
Jakovljević Tamara, Čobrenović Ana, Ranković Biljana

HOLISTIC APPROACH TO CONSULTING FOR QUALITY SYSTEM AND OTHER MANAGEMENT SYSTEMS 1190
Trajković Ana, Mihić Branimirka

FMEA APPLICATION IN RISK MANAGEMENT AS RESPONSE TO THE ISO 9001:2015 REQUIREMENTS 1198
Markovic Sanja, Ruso Jelena, Horvat Ana

QUALITY OF SOCIAL RESPONSIBILITY ACTIVITIES AND STAKEHOLDERS NEEDS IN SERBIAN EDUCATIONAL INSTITUTIONS 1205
Lukić Bojana, Glogovac Maja, Živković Nedeljko

WHO IS GOING TO BE MORE INTERESTED IN ISO 50001 CERTIFICATION? 1213
Kandić Sanja

THE ROLE OF HIGHER EDUCATION IN BUILDING AND IMPROVING NATIONAL QUALITY INFRASTRUCTURE – THE CASE OF SERBIA 1220
Ruso Jelena, Filipović Jovan, Pejović Gordana

THE ROLE AND THE PERCEPTION OF THE STANDARD ISO 22000 1225
Jovanović Luka, Ilić Milica, Đurić Mladen

INNOVATIVE STRATEGIES FOR NEW COMPETENCE DEVELOPMENT – BRINGING THE REAL WORLD IN HIGHER EDUCATION 1235
Mijatovic Ivana, Damnjanovic Vesna

SOFTWARE QUALITY ASSURANCE 1242
Marković Sara, Stojanović Katarina, Đurić Mladen

QUALITY MANAGEMENT

PERCEPTION OF BENEFITS - GUIDELINES FOR THE APPLICATION OF ISO 9001:2015

Jelena Cice*[1], Ivan Pribićević[1], Strahinja Kočijašević[2]
[1]Executive Director at Quality Austria Center, Business Development Manager at TMS CEE
[2]Faculty of Organizational Sciences
*Corresponding author, e-mail: elena.cice@qualityaustria.com

Abstract: *ISO 9001, the world's leading quality management standard, has recently been revised. The new version follows a new, higher level structure to make it easier to use in conjunction with other management system standards. With over 1.1 million certificates issued worldwide, ISO 9001 helps organizations demonstrate to customers that they can offer products and services of consistently good quality. It also acts as a tool to streamline their processes and make them more efficient. Focus of the paper is on the technical specification ISO/TS 9002 that is currently under development to help organizations easier application of ISO 9001. Based on a research performed using simple questionnaire among various organizations in Serbia, study presents the results on the awareness of the revision of ISO 9001:2015, expected benefits of quality management system implementation as well awareness on possible need and benefits of the guidelines given in the ISO/TS 9002.*

Keywords*: ISO/TS 9002, ISO 9001, quality management, revision, guidelines, benefits, improvement*

1. INTRODUCTION

International Organization for Standardization is an independent, non-governmental international organization with a membership of numerous national standards bodies. Through its members, it brings together experts to share knowledge and develop voluntary, consensus-based, market relevant international standards that support innovation and provide solutions to global challenges. International standards give world-class specifications for products, services and systems, to ensure quality, safety and efficiency. They are instrumental in facilitating international trade. Standards are developed by the people that need them, through a consensus process. Experts from all over the world develop the standards that are required by their sector. This means they reflect a wealth of international experience and knowledge as explained by International Organization for Standardization (2016).

Taking into account that the ISO 9001 is the internationally most popular standard for quality management systems based on ISO Survey (2014), it is crucial to pay adequate attention to recent revision of the requirements given in the standard. In addition, it can be useful to give some overview of importance of technical specification ISO/TS 9002 that is currently under development as guidance on effective implementation of ISO 9001:2015 among organizations in Serbia. Led by these drivers, survey presented in the paper is based on the following hypothesis that will be concluded in the final chapter of the paper:

- H0: Organizations in Serbia are aware of the benefits in their quality management system implemented according to the requirements of ISO 9001:2015.
- H1: Organizations in Serbia are aware of the development of the new technical specification ISO/TS 9002 and its possible practical usage.
- H2: Guidance given in the ISO/TS 9002 will be applied in organizations in Serbia to assist in the implementation of management systems based on ISO 9001:2015 requirements.

Latest available survey from the International Organization for Standardization (2014) is showing of the information that was used for the survey analysis, on the number of certificates for quality management systems according to the standard ISO 9001 issued for the organizations in Serbia, in the previous years are shown in the Table 1. Assumption is that overall number of ISO 9001 certificates exceed the numbers shown in this survey. For the purpose of this paper official available data will be used.

Table 1: Total number of ISO 9001 certificates in Serbia ISO Survey (2014)

Country	2010	2011	2012	2013	2014
Serbia	1790	3228	2750	2366	2637

In the same survey from the International Organization for Standardization (2014), considered data were related to the industrial sectors in Serbia and number of certificates in each one of them:

Table 2: Number of ISO 9001 certificates in Serbia by industrial sector ISO Survey (ISO, 2014)

Sector	Number of certificates
Agriculture, fishing and forestry	17
Mining and quarrying	20
Food products, beverage and tobacco	207
Textiles and textile products	28
Leather and leather products	4
Manufacture of wood and wood products	18
Pulp, paper and paper products	19
Publishing companies	4
Printing companies	24
Manufacture of coke & refined petroleum products	5
Nuclear fuel	0
Chemicals, chemical products and fibers	47
Pharmaceuticals	46
Rubber and plastic products	75
Non-metallic mineral products	17
Concrete, cement, lime, plaster etc.	28
Basic metal and fabricated metal products	160
Machinery and equipment	93
Electrical and optical equipment	95
Shipbuilding	1
Aerospace	1
Other transport equipment	27
Manufacturing not elsewhere classified	26
Recycling	10
Electricity supply	6
Gas supply	7
Water supply	7
Construction	276
Wholesale and retail trade, repairs of motor vehicles	298
Hotels and restaurants	36
Transport, storage and communication	72
Financial intermediation, real estate, renting	13
Information technology	42
Engineering services	160
Other Services	116
Public administration	34
Education	42
Health and social work	43
Other social services	30

2. SHORT HISTORY OF THE ISO 9000 FAMILY OF THE STANDARDS

In the early days of developing first standards to this topics, according to the presentation from the working group 23, from the committee for management systems standardization ISO/TC176 (2012), a new work item proposal for three quality assurance “requirements” standards (ISO 9001, ISO 9002, and ISO 9003) was submitted to International Organization for Standardization in 1979. International Organization for

Standardization established its first committee for management systems standardization - ISO/TC 176. While the Deming Award Prize already existed in Japan, the Malcolm Baldrige Prize was just starting in the USA and soon afterwards the EFQM Business Excellence model in Europe, so it was decided to develop an additional standard giving extended guidance on the topic of quality, referred to as ISO 9004. During the development of these initial standards, it was decided that it would be better to place all the technical terminology in a separate glossary, ISO 8402, rather than repeating it in each standard. With five standards under development, feedback was received indicating that there was a need to explain the relationship between the different standards. Consequently, work was started on ISO 9000 "Selection and Use". ISO 8402 was published in 1986, with ISO 9000, ISO 9001, ISO 9002, ISO 9003 and ISO 9004 being published in 1987. Further feedback indicated that there was a need to provide users with application guidance for implementing ISO 9001, ISO 9002 and ISO 9003. It was then agreed to re-number ISO 9000 as ISO 9000-1, and to develop ISO 9000-2 as the desired application guidelines. While the initial editions of the ISO 9001, ISO 9002 and ISO 9003 standards had a distinctly "manufacturing" feel to them, there was growing recognition of the need to improve software quality. So it was decided to create a standard specifically giving guidance on quality for software, ISO 9000-3. There was also an historic association between the fields of quality, statistics, and maintenance and reliability. This led to the development of ISO 9000-4 on Dependability Management.

By the early 1990s, TC 176 was beginning to realize that it needed to consider the future revision and development of its standards, and so it produced a critical document called "Vision 2000" setting out a proposed path forward. One feature of Vision 2000 was to emphasize the difference between the basic introductory standards in the series, as compared to the requirements standards, and then the guidance standards going beyond the basic requirements standards. More feedback from the market emphasized the need to provide guidance on quality to the Services sector, but noting the recommendations in Vision 2000, it was decided to develop this as a part to ISO 9004, rather than as a part to ISO 9000. Consequently, ISO 9004 was renumbered as ISO 9004-1, and the very successful ISO 9004-2 on services was published.

ISO 9001:1987 and later ISO 9001:1994, contained 20 sub-clauses under clause 4, each addressing a different issue about quality. Feedback from the market suggested that there was a need for more detailed guidance on some of these topics, than was being provided through the generic application guidance in ISO 9000-2.

By the late 1990s, the ISO 9000 "family" of standards had grown to some 21 different standards as well as a number of supporting guidance notes and informative brochures.

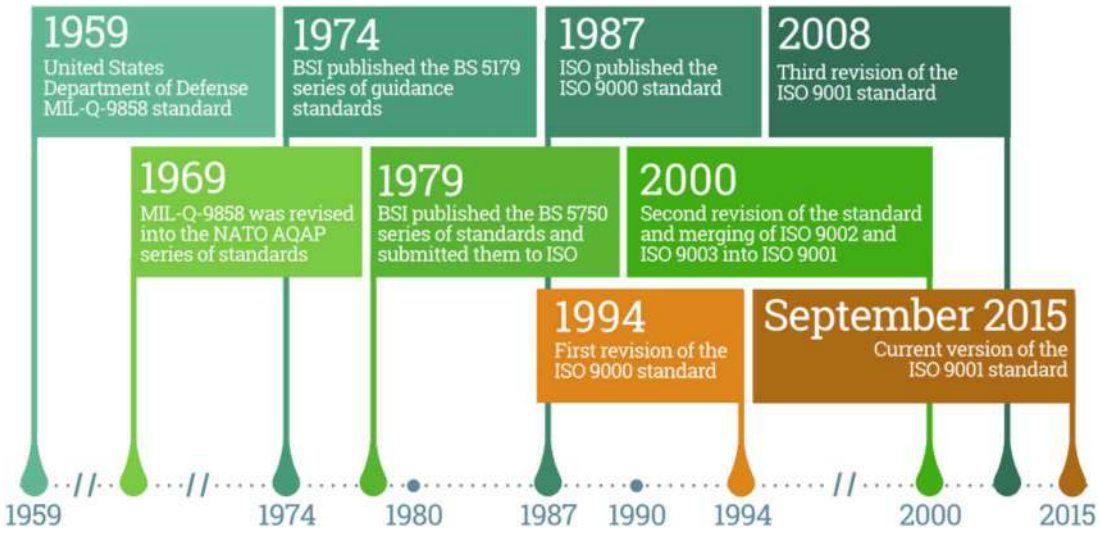


Figure 1: The history of quality management system standards by Advisera (2016)

Today, as presented by the International Organization for Standardization (2016) "*The ISO 9000 family addresses various aspects of quality management and contains some of ISO's best known standards. The standards provide guidance and tools for companies and organizations who want to ensure that their products and services consistently meet customer's requirements, and that quality is consistently improved*."

Standards in the ISO 9000 family include following basic set of the most important requirements or guidelines that can help various organization in not only implementing but also sustainably improving their quality management systems:

- ISO 9001:2015 - Quality management systems - Requirements.
- ISO 9000:2015 - Quality management systems - Fundamentals and vocabulary.
- *ISO/DTS 9002 - Quality management systems - Guidelines for the application of ISO 9001:2015*
- ISO 9004:2009 - Managing for the sustained success of an organization - A quality management approach
- ISO 19011:2011 - Guidelines for auditing management systems

2.1. Considerations on the revised ISO 9001:2015

ISO 9001 is the international standard that specifies requirements for a quality management system. Organizations use the standard to demonstrate the ability to consistently provide products and services that meet customer and regulatory requirements. It is the most popular standard in the ISO 9000 series and the only standard in the series to which organizations can certify. The current version of ISO 9001 was released in September 2015. The new version follows a new, higher level structure to make it easier to use in conjunction with other management system standards, with increased importance given to risk.

As explained by the American Society for Quality (2016), "*organizations of all types and sizes find that using the ISO 9001 standard helps them:*

- *Organize processes*
- *Improve the efficiency of processes*
- *Continually improve*

All organizations that use ISO 9001 are encouraged to transition to ISO 9001:2015 as soon as possible. This includes not only organizations that are certified to ISO 9001:2008, but also any organizations involved in training or certifying others.

Changes introduced in the 2015 revision are intended to ensure that ISO 9001 continues to adapt to the changing environments in which organizations operate. Some of the key updates in ISO 9001:2015 include the introduction of new terminology, restructuring some of the information, an emphasis on risk-based thinking to enhance the application of the process approach, improved applicability for services, and increased leadership requirements.

Organizations and individuals that use ISO 9001 are encouraged to transition to the 2015 revision as soon as possible. However, the International Accreditation Forum (IAF) and the ISO Committee on Conformity Assessment (CASCO) have agreed to a three-year transition period from the publication date of ISO 9001:2015."

Strategic objectives of the performed revision of the standard ISO 9001 were:

- Taking into account of changes in quality management systems practices and technology since its last major revision that took place back in 2010,
- To provide a stable core set of requirements for the next 10 years or more,
- To ensure the reflection of changes in the increasingly complex, demanding and dynamic environments in which organizations operate and
- To ensure the facilitation of effective implementation and effective conformity assessment.

Short overview of the content in the current version of the standard ISO 9001:2015 is given as follows:

Figure 2: ISO 9001:2015 Preview of content by ISO (2016)

In the text prepared by Lazarte (2015), acting ISO Secretary-General Kevin McKinley explains: "*ISO 9001 allows organizations to adapt to a changing world. It enhances an organization's ability to satisfy its customers and provides a coherent foundation for growth and sustained success.*"

The 2015 edition features important changes, which Nigel Croft, Chair of the ISO subcommittee that developed and revised the standard, refers to as an "*evolutionary rather than a revolutionary*" process. "*We are just bringing ISO 9001 firmly into the 21st century. The earlier versions of ISO 9001 were quite prescriptive, with many requirements for documented procedures and records. In the 2000 and 2008 editions, we focused more on managing processes, and less on documentation. We have now gone a step further, and ISO 9001:2015 is even less prescriptive than its predecessor, focusing instead on performance. We have achieved this by combining the process approach with risk-based thinking, and employing the Plan-Do-Check-Act cycle at all levels in the organization. Knowing that today's organizations will have several management standards in place, we have designed the 2015 version to be easily integrated with other management systems. The new version also provides a solid base for sector-quality standards (automotive, aerospace, medical industries, etc.), and takes into account the needs of regulators.*"

As the much anticipated standard comes into being, Kevin McKinley concludes, "*The world has changed, and this revision was needed to reflect this. Technology is driving increased expectations from customers and businesses. Barriers to trade have dropped due to lower tariffs, but also because of strategic instruments like International Standards. We are seeing a trend towards more complex global supply chains that demand integrated action. So organizations need to perform in new ways, and our quality management standards need to keep up with these expectations. I am confident that the 2015 edition of ISO 9001 can help them achieve this.*"

2.2. Purpose of the new ISO/TS 9002

Based on the International Organization for Standardization (2016) announcements technical specification ISO/TS 9002 is under development to assist users in the implementation of a quality management system based on ISO 9001:2015. It will provide guidance on the requirements in ISO 9001:2015, with a clause by clause correlation to clauses from 4 to 10 as shown in Figure 2 for ISO 9001.

Technical specification of ISO/TS 9002 (2016) will give examples of what an organization can do, but it does not add new requirements to ISO 9001:2015. The examples in technical specification are not definitive and only represent possibilities, not all of which are necessarily suitable for every organization.

ISO 9001:2015 contains requirements that can be objectively audited or assessed. ISO/TS 9002 will include examples, descriptions and options that aid both in the implementation of a quality management system and in strengthening its relation to the overall management of an organization.

While the guidelines will be consistent with the ISO 9001:2015 quality management system model, they will not be intended to provide interpretations of the requirements of ISO 9001:2015 or be used for audit or assessment purposes.

ISO/TS 9002 (2016) will be used by different organizations and implementation can vary based on types, sizes, levels of maturity and sectors and geographic locations. Based on these facts main purpose of survey presented in this paper was to present expectations of organizations in Serbia on this matter.

3. RESULTS OF THE RESEARCH AMONG ORGANIZATIONS IN SERBIA

In order to have factual data as a basis for objective conclusions on the hypothesis, comprehensive but simple survey was performed among 101 organizations from public and private sectors in Serbia. Survey had consisted of 11 questions towards locations, size, scope and similar data about companies as well on questions related to existing quality management system, perceived benefits of revised ISO 9001:2015 and awareness of developing of the technical specification ISO/TS 9002 and related guidance on implementing ISO 9001:2015. Results of the survey are given in the following figures and tables.

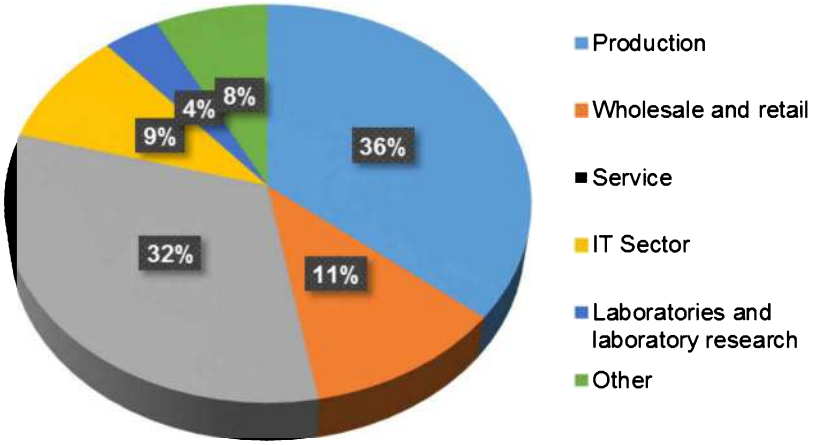


Figure 3: Industry sector of an organization

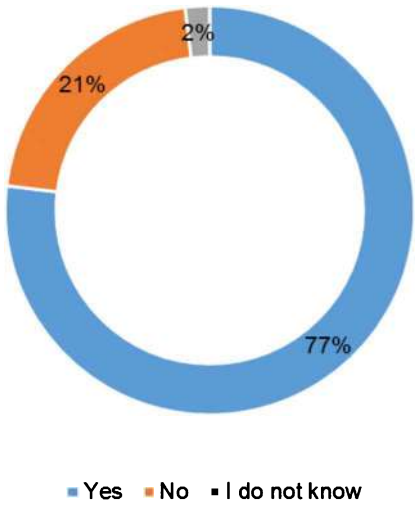


Figure 4: Did your organization implement Quality Management System - ISO 9001?

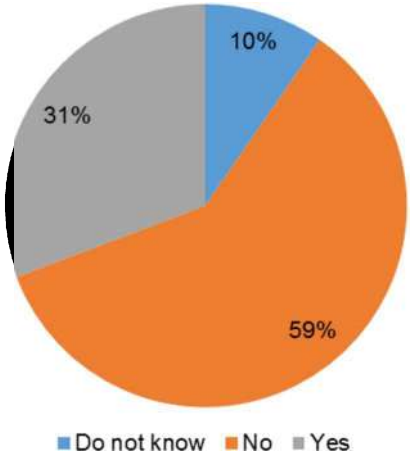


Figure 5: If your organization has been implemented a quality management system before, is it performed transition to the ISO 9001:2015?

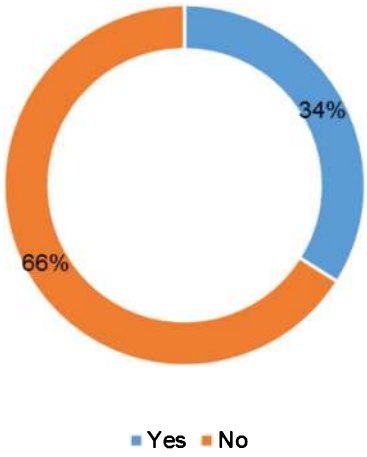


Figure 6: Do you know what technical specification ISO/TS 9002 is?

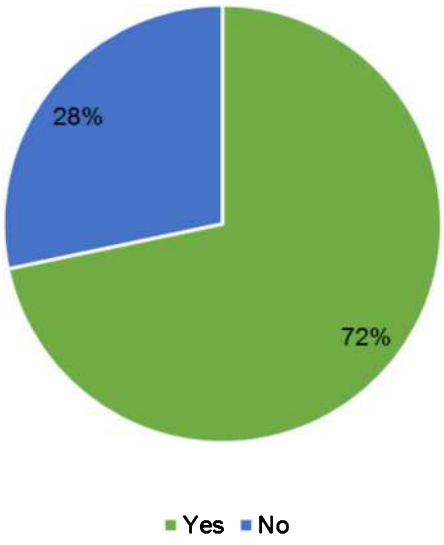


Figure 7: Do you believe that you need additional guidance on the interpretation and application of ISO 9001: 2015?

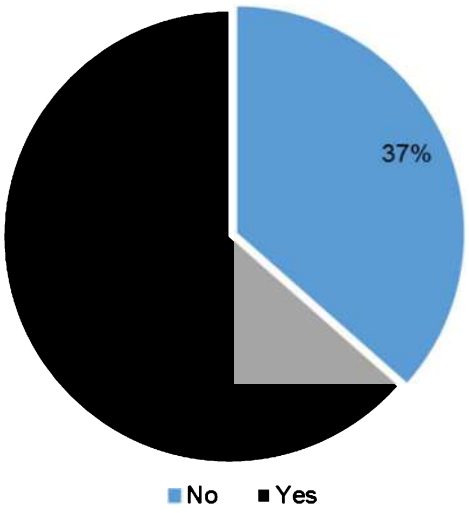


Figure 8: Do you think there is a need to adopt ISO/TS 9002 or ISO 9001:2015 is sufficient to implement the requirements for quality management system?

Conclusions of this survey are that organizations in Serbia are not familiar with existence of ISO/TS 9002 and their possibilities for better implementation of ISO 9001:2015 requirements and improving of business processes. Also, there is big demand for more assistance and information regarding interpretation of ISO 9001:2015 requirements.

The most useful information to give some additional conclusions is given in the Table 3 which consist of the answers given by the representatives from the organizations. They have been given different explanations on possible benefits from implementing revised version of the standard ISO 9001:2015 requirements:

Table 3: What are the benefits from implementing ISO 9001:2015?

Benefits (in %)	Companies ≤ 100 employees	Companies > 100 employees
Less paperwork	72	85
Winning tenders	61	78
Better risk and control management	53	60
The improvement of supply chain	39	67
Better clients' satisfaction	29	53
Easier implementing of EMS & OHS	21	47
Other	18	27

4. CONCLUSION

Considering results of the presented survey and the experts' opinion on the importance and methods of implementing concepts and principles of quality management in the various organizations, following conclusions can be related to the initial hypothesis:

- H0: Organizations in Serbia are aware of the benefits in their quality management system implemented according to the requirements of ISO 9001:2015. - C0: Most of the organizations are aware of the benefits they are pursue by effective quality management system although, on the other side, most of them still perceive the greatest benefit in two areas of easier participation on the tenders and less administrative bureaucracy related to control of paper documentation. There is still room for trying to express more benefits related to some other, more quantitative performance indicators like examples from the study on "Economic benefits of standards" explained by Gerundino, Weissinger, Grosfort and Damond (2014).
- H1: Organizations in Serbia are aware of the development of the new technical specification ISO/TS 9002 and its possible practical usage. - C1: Most of the organizations are not aware of the current development of the neither technical specification nor what it is the planned purpose of it.
- H2: Guidance given in the ISO/TS 9002 will be applied in organizations in Serbia to assist in the implementation of management systems based on ISO 9001:2015 requirements. - C2: Unless experts from the quality management system, representatives of institutes and universities as well top managers of the organizations themselves do not use maximum effort in spreading information on the importance and usefulness of the future technical specification ISO/TS 9002, there is a short chance that organizations

themselves nor different kind of consultants in this area will use ISO/TS 9002 on a big scale as a support to implementation of the ISO 9001:2015 requirements in Serbia.

Inputs for the future researching on the topics presented in the paper can indicate some of the following thesis in order to prepare beneficial results and practical guidance to the interested professionals and organizations that have implemented quality management system based on the ISO 9001 and possible guidance given in the future ISO/TS 9002:

- There is a great need of using additional methods of getting closer to current developments in the field of quality management relevant to the representatives of the organizations in Serbia based on the presented survey results from April 2016 in this paper.
- Internal and external trainings and workshops for the quality management representatives are essential for creating knowledge database that can be systematically explored in the various organizations as discussed by Schachner (2015) and emphasized by Smida (2015). It will be significant to research what level of improvement in organization can be generated through development of knowledge management system.
- If organizations on the worldwide scale and also it applies to Serbia as well, are aware of the risk based approach and using some of the simple risk assessment techniques to perceive strengths and weaknesses of their quality management system and processes they can be able to use more effective strategy and decision making models in order to maximize benefits of their management systems as also indicated by Bauer (2015) and Garscha (2015).

As changes in internal and external context of the organization are immanence to all kind of organizations it can be useful to organizations in Serbia to use more tools or guidelines, like given in the ISO/TS 9002, in order to be prepared to adequately react on time in the ever-changing conditions for existence of the successful business. Otherwise they can suffer from the shortage of information present and available but not used by the organizations as a lack of systematic approach to concepts like change management and analysis of internal and external issues using strength/weaknesses and threats/opportunities analysis or consideration of the political, economic, social and technological factors used to assess the market for a business or organizational unit as concluded by Pelzmann and Koubek (2015) as well as Pölz (2015).

REFERENCES

Advisera. EPPS Services. (2016). *ISO 9001:2015 revision – List of helpful materials*. Retrieved from http://advisera.com/9001academy/iso-9001-2015-revision/

American Society for Quality. (2016). *ISO 9001:2015*. Retrieved from http://asq.org/learn-about-quality/iso-9000/iso-9001-2015/

Bauer, E. (2015). *ISO 9001 Revision explained in simple terms*. Concept of “Risk-Based Thinking”. Quality Austria GmbH.

Garscha, B.J. (2015). *ISO 9001 Revision explained in simple terms*. Process Approach. Quality Austria GmbH.

Gerundino, D., Weissinger, R., Grosfort, J., & Damond, X. (2014). *Economic benefits of standards*. Switzerland: International Organization for Standardization

Hackenauer, W. (2015). *ISO 9001 Revision explained in simple terms*. Performance Evaluation. Quality Austria GmbH.

International Organization for Standardization. (2014). *ISO Survey 2014*. Retrieved from http://www.iso.org/iso/iso-survey

International Organization for Standardization. (2015). *Implementation Guidance for ISO 9001:2015*. Retrieved from www.iso.org/tc176/sc02/public

International Organization for Standardization. (2016). *ISO 9000 - Quality management*. Retrieved from http://www.iso.org/iso/home/standards/management-standards/iso_9000.htm

International Organization for Standardization. (2016). *ISO 9001 Quality Management Systems: Revision*. Retrieved from http://www.iso.org/iso/home/standards/management-standards/iso_9000/iso9001_revision.htm

International Organization for Standardization. (2016). *ISO/DTS 9002 Quality management systems -- Guidelines for the application of ISO 9001:2015*. Retrieved from http://www.iso.org/iso/catalogue_detail.htm?csnumber=66204

International Organization for Standardization. (2016). *ISO/TS 9002*. Retrieved from https://committee.iso.org/sites/tc176sc2/home/projects/ongoing/iso-ts-9002.html

ISO/TC176/SC2/WG23. (2012). *ISO 9001 - 25 years: 1987 - 2012*. Version 3. British Standards Institution

Lazarte, M. (2015). ISO 9001:2015 - Just published! Retrieved from http://www.iso.org/iso/home/news_index/news_archive/news.htm?refid=Ref2002

Pelzmann, S., & Koubek, A. (2015). *ISO 9001 Revision explained in simple terms*. Context of the Organization. Quality Austria GmbH.

Perry Johnson Registrars, Inc. (2015). *Preparing for the Change – Transition to ISO 9001:2015*. Retrieved from www.pjr.com
Pölz, W. (2015). *ISO 9001 Revision explained in simple terms*. Changes. Quality Austria GmbH.
Schachner, W. (2015). *ISO 9001 Revision explained in simple terms*. Knowledge of the Organization. Quality Austria GmbH.
Smida, F. (2015). *ISO 9001 Revision explained in simple terms*. Awareness. Quality Austria GmbH.
Smida, F. (2015). *ISO 9001 Revision explained in simple terms*. Competence. Quality Austria GmbH.

PARADIGM EVOLUTION: FROM LINEARITY TO COMPLEXITY IN THE WORLD OF QUALITY MANAGEMENT

Miloš Borisavljević[1], Miloš Nedeljković*[1], Mladen Đurić[1]
[1]University of Belgrade, Faculty of Organizational Sciences
*Corresponding author, e-mail: milos1994nedeljkovic@gmail.com

Abstract: *The latest management concepts, which are based on nonlinear dynamical models, differ significantly from the traditional concepts intertwined by linearity, which are created for the world that seized to exist a long time ago. Such concepts, that include adaptability, nonlinearity and holistic approach, can provide a broader picture of the organization and the space in which it exists, which is a prerequisite for the creation of more adequate quality management mechanisms and solutions. This paper presents specific concepts and phenomena that were previously observed in some natural sciences and whose applicability can be found in different processes of organizational systems. The discussion on complex adaptive systems should lead to a better understanding of the organizational processes. The reason for the inclusion of the complex adaptive systems and the complexity theory in the management and quality management approaches lies primarily in a desire to create a more resilient and more flexible organizational system that learns and evolves, which is also a requirement of the lastest version of ISO 9001 standard. As is written in the new ISO 9000:2015 that „an organization's QMS model recognizes that not all systems, processes and activities can be predetermined; therefore it needs to be flexible and adaptable within the complexities of the organizational context", we recognize complex adaptive systems theory as an appropriate framework for making these concpets live in operational practices of organizations' quality maanagement systems.*

Keywords*: organization, quality management, complexity, complex adaptive systems, ISO 9000*

1. INTRODUCTION

The beginning of the XX century was marked by the development of management as a scientific discipline. Frederic Taylor, the creator of the scientific management theory, based his work on the need to increase productivity, i.e. industrial efficiency. Productivity was the most important factor of success in this era, so the entire focus was on manufacturing. The basic assumption was that only increasing the efficiency of the process would increase productivity as well. Further research of Taylor and his contemporaries came to the conclusion that the processes must be carefully designed and that the most suitable man should be selected for them. Even a linear approach like this one gave good results at that time and represented a major progress. However, nowadays it is simply impossible to manage the organization as a linear system.

Numerous management concepts that were created later have increasingly estranged from understanding the organization as a linear system. The latest concepts observe the organization as a highly nonlinear dynamic system that exists in a nonlinear, even chaotic, dynamic environment.

Variable, turbulent, often unpredictable business environment requires a greater level of adaptability from the organization. A long-time trend that shows great instability of the global world market, which is very susceptible primarily to economic and political influence, imposes organizational leaders to apply different management approaches to make their organizations more flexible. The challenges that organizations are dealing with have become more complex and traditional management approaches and the way that they are designed have not given the necessary flexibility. In an era characterized by nonlinearity and complexity, leaders primarily need to change the way they conceptualize solutions for the problems they face in managing organizations.

Today, people care about different things, they are better informed, more educated, but also better connected than in the past. Their expectations from the company, whether they take the role of customer/consumer, suppliers, investors or members of the community, are changing rapidly. Unfortunately, most companies have not evolved enough to keep up with all these changes and continue to operate by using the way of thinking and practice that was suitable for a very different world. (Mackey & Sisodia, 2013)

The system approach to management represents the basis and the starting point for analyzing the environment, changes and creating a solution for management systems. Taking into account the concepts of the systems theory, we can come to a better understanding of the problems and the mechanisms by which they can be solved.

The complexity theory as part of the systems theory provides a number of aspects through whose prism the organizational systems can be studied. The subject of studying in complexity theory is a nonlinear dynamic system, and since the organizations are nonlinear dynamic systems they fulfill this assumption. Through the prism of the complexity theory and the theory of complex adaptive systems, which are based on a systematic approach, observation and study of the management system of the organization can bring a completely new management approaches and concepts.

The basic concepts taken from the theory of complex adaptive systems and the complexity theory, which are increasingly present in the world of management, will be presented by the literature review.

2. FUNDAMENTALS OF THE COMPLEX ADAPTIVE SYSTEMS THEORY

Complex adaptive systems (CAS) are systems composed of a large number of interdependent components and agents with mutual interactions (Sammut-Bonnici, 2014; Doyle, Watz, & Portrey, 2015). Sammut-Bonnici (2014) notes that all components of CAS work as a whole and have the ability to learn through experience so they can adapt to changes that occur in the environment. Doyle, et al. (2014) observe agents as autonomous system components that are able to observe, analyze, decide and act taking into account information obtained from the environment and set goals.

Similar to the authors Domingues et al. (2015), Palmberg (2009) Bonabeuau & Meyer (2001), Rouse (2008) he defines some of the main characteristics of CAS:

- They represent the non-linear dynamic systems whose behavior and actions can become chaotic or random, depending on the nature of the system.
- They are composed of independent agents (or partially dependent) whose behavior is based on the physical, psychological or social rules.
- Because the needs and desires of agents (which are stated in their rules) are not homogeneous, their goals and behavior are often in conflict. In response to these conflicts and competitiveness, agents tend to adapt the behavior of each other.
- The agents' intelligence is limited. When they experiment and gain experience, they learn and change their behavior accordingly.
- Adaptation and learning tend to be only the outcome of the organization. The patterns of behavior arise before than being designed into the system.
- There is no central point of control. The behavior of the system is usually unpredictable and uncontrollable and no one is "the boss".

The model of the complex adaptive systems, except the inputs and outputs in the form of information, substance and energy, contains a system of simple rules, which defines the rules by which the system agents respond to the impacts detected by the system, whether they come from the system or from the environment. It is important to note that feedback allows adaptive learning which has a direct effect on the evolutionary mechanism of the system. Neikam (2015) mentions the importance of designing an organizational system model according to CAS because of the benefits in the form of co-evolution, which means that the system reacts in the same way to the environment aiming to create a suitable climate.

Sammut-Bonnici (2014) suggests that it would be extremely risky to transform organizational models into those which only involve self-organization, primarily because there is a possibility of the occurrence of chaos and the inability to predict any results of the system because he is not guided, i.e. it is not directed towards a determined direction, but should transform only those processes and parts of the system, according to the CAS, which in practice appear sustainable and efficient. CAS theory contributes more holistic view of the organizational system (Dooley, 1997).

2.1. Swarm intelligence

A large number of the world's leading organization accepts new concepts of management resulting from the theory of complex adaptive systems in order to maintain a competitive advantage through innovation. One of the new concepts that is based on complexity is swarm intelligence. Many companies like "Unilever", "Southwest Airlains" and others have adopted this approach to solve some of their problems. Primarily, the

approach is based on optimization of different business operations and provides greater flexibility, robustness and self-organization (Bonabeau & Meyer, 2001).

The swarm intelligence is a specific pattern of behavior of certain chaotic systems composed of a large number of individual agents that are manifested through their association to solve the problem by putting efforts toward a common goal.

The term is taken from the natural sciences, and it is best illustrated through the natural phenomena on which they were named, whether they are swarms of bees, a school of fish or a colony of ants. There are so many scientific programs about animals which are studying only the form of their behavior in a group. A flock of killer whales who use well-coordinated tactics and clear communication to surround the seal, a herd of wolves who are trying to isolate the buffalo calves from the herd by using an excellent coordination and strategy or a colony of ants that join forces to defend their habitat from attack or self-organize the shipment of food into their colony, are some examples of united intelligence of individual agents who represent on a higher level an intelligence of the group.

3. ORGANIZATIONAL AND QUALITY MANAGEMENT SYSTEM FROM THE ASPECT OF THE COMPLEX ADAPTIVE SYSTEMS THEORY

Mechanisms of early management concepts show a high degree of linearity, but as management theory and practice evolved more and more of these concepts carried nonlinearity in them. The concepts of today such as knowledge management, but also the management of complexity, base their mechanisms on forms that are adaptive and variable in space and time.

During XX century, the development of production technology has fundamentally influenced not only the society but also the logic of business and organization. Similarly, the dominance of the development of information technology at the turn of the XXI century affects not only the way of communication between people but also the organization. These trends require organizations that can combine efficiency with flexibility and innovation. (Palmberg, 2009)

Traditional quality management systems are based on hierarchy and centralization which means that information flows are directed from top to bottom and they are precisely defined. Contrary to them, quality management based on the complexity theory enables consideration of an organization as a decentralized system where information flows in all directions and where the level of bureaucracy is on a very low level. (Olmedo, Sancho, Meteos, & Valderas, 2002). Rouse (2008) provides a comparison table (Table 1) of differently oriented organizational models, i.e. traditional and complex adaptive organizational systems.

Table 1: A comparison of the characteristics of organizational systems (Rouse, 2008)

Criterion	Traditional	Complex adaptive
The role of top management	Management	Leadership
Methods	Command and control	Initiative and inhibition
Measurements	Activities	Results
Focus	Efficiency	Agility
Relations	Contractual and specified	According to personal discretion
Network	Hierarchical	Heterachical
Design	Organizational design	Self-organization

Setting the organization in the context which implies that it is a part of an environment that actually represents the system at a higher level of decomposition and taking into account factors that may affect the system, which is one of the most important changes in new ISO 9001:2015, can contribute to more efficient management and increase resilience of an organizational system. It should be noted that the model that defines the context must be adequate to the situation. Olmedo et al. (2002) note that linear models of dynamic systems can facilitate understanding of the basis and functioning of the system but such models contain a very simplified picture of the real situation with a known and determined environment, which in reality is not the case. Also, behaviour patterns that occur are well-known so that such a model does not imply evolution, learning and adaptability.

Although the organizations as open systems are exposed to the influence of environment, also the environment is exposed to its impacts, to a greater or lesser extent. Dulanovic and Jasko (2008) note that organizations need to adapt to the environment but also depending on how much power they have, they can

adapt the environment to their needs. The progressive growth in the number of organizations has led to the increased complexity of global environment in which they exist.

It is generally accepted (Wheatley, 1993; Domingues, Sampalo, Arezes, 2015; and others) that organizations and theit management systems are dynamic systems with a large number of nonlinear interactions both within its system and also with the dynamic but turbulent environment.

As for any other management system, we can say for a quality management system that „under certain circumstances, regularly behave in a predictable way. Under other conditions they exhibit a behavior in which the regularity and predictability are disappearing. Almost invisible differences in the initial conditions lead to the gradual divergence of systemic reactions compared to the normal state until the behavior of the system becomes very different (Rosenhead, 1998)."

Certain characteristics recognized by many authors (Domingues, Sampalo, Arezes, 2015; Palmberg, 2009; Bonabeuau & Meyer, 2001; and others) define the organization as a complex adaptive system, and some of them are especially important from the angle of the quality management system:

- A large number of different agents, with their interactions, make the system "alive" such as employees and other stakeholders and interested parties, as well as equipment, structure, organization, etc.
- The learning, which is increasingly represented as a management concept, also appears in the ISO standards for quality management systems (ISO, 2015b), involves the generation of knowledge upon which the organizational systems form patterns of their behavior. It is certainly a very important characteristic that gives the adaptability to the system.
- The co-evolution – as already mentioned, the organization is an open system that is subject to influences, but also the environment is a subject to influences that are coming from the organization, so this feature provides a space-time dimension to the changes that occur and represent an evolutionary trait of all participating systems.
- The complexity – numerous nonlinear interactions between agents of the system from which arises indeterminate behavior patterns.
- Emergence – because of its complexity and the imposed requirements, an organization creates certain patterns and mechanisms: the ISO 9000 family should be percieved as a set of solutions aggregated from the good practice, given the management practices and technologies utilized throughout the world.
- Self-organization as a mechanism that initiates the formation of specific patterns of behavior and it contains a system of simple rules by which it functions.
- Organizational systems are assembled from parts, sectors and departments that can be changed, abolished and/or added which is usually achieved by reengineering of business processes, so the principle of modularity is contained in the assumption that organizations possess this characteristic. Modularity is very important when it comes to adaptability because it gives more flexibility.

4. LEARNING AND AUTOPOIESIS THEORY AS A POTENTIAL BASES FOR SUCCESSFUL IMPLEMENTATION OF ISO 9001:2015 IN COMPLEX ENVIRONMENTS

In terms of the new ISO 9000 series, we are guided to understand that „organizations share many characteristics with humans as a living and learning social organism. Both are adaptive and comprise interacting systems, processes and activities." (ISO, 2015a). Also, the same document states that organizational QMS „needs to be flexible and adaptable within the complexities of the organizational context", with the following requirements which imply that appropriate learning and knowledge management processes are vital in achieving this. We here present the autopoiesis theory as one potential way of understanding how this set of requirements may be fulfilled in a complex enviroment.

"The concept of 'autopoiesis' essentially is the system, which is organized as a network of production processes components which continue to produce components that are using their mutual interactions and transformations that continually regenerate and realize the network of processes that produces them. Components in some way constitute the system as a unit in the area, in which they (the components) exist by specifying their implementation in such a network topology." (Varela, 1979)

In "autopoiesis" theory, the organization can be seen as a transfer or flow of knowledge whose characteristics change - new ones are created and old ones are abandoned. Knowledge is flexible, available to members of the organization and linked to the organizational history. (Von Krogh & Roos, 1995). Maturana and Varela (1987) note that this theory largely depends on the "observer". The observer is always a man as an agent of organizational system and all cognitive processes and learning processes rely on its objectivity or subjectivity.

Individual knowledge through social communication creates the phenomenon of organization and organizational knowledge (Maula, 2006). The organization is formed through the interaction of people and their merger. One of the phenomena of „autopoiesis“ theory is structural coupling. This is actually the assumption of co-evolution, but essentially means two individual entities or entity and its environment where their mutual interactions over many repetitions create compatibility of these two systems or entities and create a unique trajectory (Maturana & Varela, 1987).

Furthermore, knowledge is, as already stated, closely related to the observation (perception) and systems that can perceive are autopoietic systems. Individuals create knowledge in an autonomous way. It is based on previous knowledge and created in co-evolution with the environment. Their knowledge depends on the interaction within the organization, while the organization operates as a specific space for “structured association” that allows individual agents to reproduce cognitive processes (Von Krogh & Roos, 1995).

From the above we can observe that organizational learning is not just an ISO 9001:2015 requirement, but also a specific mechanism through which learning and knowledge management occurre and are adapted over time, while organizational systems form patterns of behavior by just using the gained knowledge.

5. CONCLUSION

Organizations are chaotic systems, as they possess certain opposing forces that are used to move the organization from a state of balance and push it into the chaos. Some forces are pushing the system to stability and order and they usually involve activities such as planning, structuring, inspection and control – all of this being very important subprocesess of the quality management, while other forces are pushing the system in the opposite direction, i.e. to instability and they include activities such as innovation, initiatives, experiments, etc. (Thietart & Forgues, 1995).

In the context of organizations and their quality management systems complexity provides a useful framework that explains how organizations behave, and how individuals and organizations interact, how to connect and survive within a larger system, i.e. environment. Furthermore, the complexity also explains why a particular influence on the processes gives unpredictable consequences and unexpected results. There is a number of intertwined links among elements within a complex system that lead to the creation of greater interdependence, which means that the changes affect the elements at all levels of the system. The changes usually occur between the elements at lower levels in parallel and then move on to the whole system (Maldonado & Gómez-Cruz, 2012).

It is important to ask the question whether it is a linear control mode suitable for the current situation and the dynamic of the environment in which organizational systems exist. Quality management system may remain without a necessary flexibility, despite the fact that it is implemented by all the details related and arising from ISO standards, national legislation, working procedures etc. These procedures are usually very complicated, sensitive to change, it takes some time to create them, but are also quite inefficient and can cause unforeseen side effects and costs. If system would work as previously discussed, minutely management would require great amount of energy and resources. Complex natural systems use self-organization that contains certain principles and thus the system operates in the desired direction (Helbing, 2009).

All of this indicates that informal systems can be more efficient and more capable of solving some problems then formal systems. The nonlinearity is very strong and emerging patterns and mechanisms lead to different dynamic of the system. In the informal system the existence of a system of simple rules or principles is very important, in order to maintain the system’s organization. Otherwise, there would be chaos and the system would be very likely to collapse.

From the perspectives of the theories elaborated in this paper, it may be concluded that quality management system acquires additonal dimensions enabling it to solve main organizational issues more efficient and effective than ever beofre.

The goal of future researches should be to find the generic concepts that can help organizations to achieve a certain degree of agility, flexibility and efficient mechanism for the collection of knowledge on the level of organization, all of these being requirements of the new ISO 9000 series.

REFERENCES

Bonabeau, E., & Meyer, C. (2001). Swarm intelligence: A whole new way to think about business. *Harvard Business Review, May 2001,* 107-114.

Domingues, P., Sampaio, P., & Arezes, P. (2015). Integrated management systems as complex adaptive systems. *Proceedings of the 8th international conference WOS, 92-102.*

Dooley, K.J. (1997). A Complex Adaptive Systems Model of Organization Change. *Nonlinear Dynamics, Psihology and Life Sciences, 1(1),* 69-97.

Doyle, M., Watz, E., & Portrey, A. (2015). Merging worlds: complex adaptive systems science meets systems engineering: a foundation for complex adaptive agent-based modeling architectures. *Proceedings of the 48th Annual Simulation Symposium,* 86-93.

Dulanovic, Z., & Jasko, O. (2008). *Osnovi organizacije poslovnih sistema.* Beograd: Fakultet organizacionih nauka.

Helbing, D. (2009). Managing Complexity in Socio-Economic Systems. European *Review, 17(2),* 423-438.

ISO (2015a). ISO 9000 – Quality management systems – Fundamentals and vocabulary. International Organization for Standardization (ISO), Geneve

ISO (2015b). ISO 9001 – Quality management systems – Requirements. International Organization for Standardization (ISO), Geneve

Mackey, J., & Sisodia, R. (2013). *Conscious capitalism: liberating the heroic spirit of business.* Boston: Harvard Business Review Press.

Maldonado, C., & Gómez-Cruz, N. (2012). *When management encounters complexity.* Bogota: Universidad del Rosario.

Maturana, H., & Varela, F. (1987). *The tree of Knowledge: The biological roots of human understanding.* Boston: New Science Library

Maula, M. (2006). *Organizations as Learning Systems: 'Living Composition' as an Enabling Infrastructure.* Emerald Group Publishing.

Olmedo, E., Sancho, M., Meteos, R., & Valderas, J. (2002). *From linearity to complexity: Towards a new economics.* Complexity International.

Palmberg, K. (2009). Complex adaptive systems as metaphors for organizational management. *The Learning Organization, 16(6),* 483-498.

Rosenhead, J. (1998). *Complexity theory and management practice.* Operational Research working papers, LSEOR 98.25. Department of Operational Research, London School of Economics and Political Science, London, UK

Rouse, W. (2008). Health care as a complex adaptive system: implications for design and management. *The Bridge, 38,* 17-25.

Sammut-Bonnici, T. (2014). Complex adaptive systems. In C. Cooper, Wiley Encyclopedia of Management.

Symposium (ANSS'15). Alexandria, VA, USA: Society for Modeling & Simulation International.

Thietart, A.R., & Forgues, B. (1995). Chaos Theory and Organization. *Organization Science, 6,* 19-28.

Varela, F. (1979). *Principles of Biological Autonomy.* New York: North Holland.

Von Krogh, G., & Roos, J. (1995). *Organizational Epistemology.* Oxford: Palgrave Macmillan.

Wheatley, M. J. (1993). *Leadership and the New Science.* San Francisco, CA, Berrett-Koehler Publishers.

Wiley, J., & Sons, Ltd. *Systems Engineering – A Foundation for Complex Adaptive Agent – Based Modeling Architectures.* Proceedings of the Annual Simulation

SOME TERMINOLOGICAL OBSERVATIONS ON ISO 9000 STANDARD SERIES WITH SPECIAL FOCUS ON ISO 9000:2015

Andrijana Đordan*[1], Gordana Jakić[2], Jelena Anđelković[2]
[1] Alfa BK University
[2] Faculty of Organizational Sciences, University of Belgrade
*Corresponding author, e-mail:anadj85@yahoo.com

Abstract: *The Institute for Standardization of Serbia (ISS), as the main national body for standardization (defined by the national Standardization Act), adopts, publishes, reviews, and withdraws Serbian standards. Promptly after the ISO 9000:2015 was published, the Institute offered its identical Serbian version entitled SPRS ISO 9000:2015 Quality Management Systems – Fundamentals and Vocabulary (SRPS ISO 9000: 2015 Sistemi menadžmenta kvalitetom – Osnove i rečnik). This paper presents some observations on terminological solutions offered both by the abovementioned standard, and the ISO 9000 Standard Series as a whole. The paper identifies challenging terminological units, analyzes them and offers possible solutions, thus indicating the need for more adequate terminology management.*

Keywords*: terminology, quality management system, ISO 9000:2015, translation, standardization*

1. INTRODUCTION

The Institute for Standardization of Serbia (ISS) as an independent, non-profit entity is the legal successor of the Federal Commission for Standardization (1946-1962), the Yugoslav Institute for Standardization (1962-1978), the Federal Institute for Standardization (1978-2003), and the Institute for Standardization (2003-2006). According to the Standardization Act ("Official Gazette of the Republic of Serbia", No. 36/2009 and 46/2015) and the Decision on Amending of the Founding Act of the Institute for Standardization of Serbia ("Official Gazette of the Republic of Serbia", No. 88/2009), this Institute is the only official national standardization body in the Republic of Serbia, and a legal entity that operates in accordance with the regulations governing the legal status of the public services.

Operating as the national organization for standardization, the Institute represents and protects interests of the Republic of Serbia in the following international and European organizations for standardization (http://www.iss.rs/):

- International Organization for Standardization (ISO); a full member since 1950,
- International Electrotechnical Commission (IEC); a full member since 1953,
- Worldwide System for Conformity Testing and Certification of Electro technical Equipment and Components (IECEE); a full member since 1965,
- European Committee for Standardization (CEN); an affiliate member since 2008,
- European Committee for Electro technical Standardization (CENELEC); an affiliate member since 2005,
- European Telecommunications Standards Institute (ETSI); a member since 2011.

International Organization for Standardization (ISO) as an independent, non-governmental international organization including 161 national standards bodies *brings together experts to share knowledge and develop voluntary, consensus-based, market relevant International Standards that support innovation and provide solutions to global challenges (*http://www.iso.org/iso/home.html). The ISO Technical Committees (TCs) are in charge of preparation of international standards, while rules for the structure and drafting of International Standards are contained in ISO/IEC Directives Part 2. At least 75% of ISO members have to support an International Standard draft for it to be published.

In this paper we are specifically interested in the ISO 9000 Standard Series that can be applied to organizations of any size. This series includes some of the ISO's best known standards that address various aspects of quality management and quality assurance providing guidance and tools for companies and organizations in order to improve quality consistently and ensure that their products and services consistently meet customers' requirements.

The ISO 9000 family comprises the following standards:
- ISO 9001:2015 - sets out the requirements of a quality management system;
- ISO 9000:2015 - covers the basic concepts and language;
- ISO 9004:2009 - focuses on how to make a quality management system more efficient and effective;
- ISO 19011:2011 - sets out guidance on internal and external audits of quality management systems.

Standard ISO 9000:2015 was originally published in 1987, but has later undergone several revisions: a major one in 2000, another one in 2008, and the final one published in September 2015, immediately followed by its Serbian version. Standard SRPS ISO 9000:2015 *Quality Management Systems – Fundamentals and Vocabulary* (*Sistemi kvaliteta menadžmentom – Osnove i rečnik*) is a product of the CASCO Technical Committee of the ISS. The ISS also embodies a technical committee named Terminology (A037), but it mainly dedicates its activities to ISO TC 37 standards.

The purpose of this paper is to draw attention to a number of terminological issues observed in this standards series, and to particularly focus on the quality, adequacy and consistency of term use in the Serbian version of ISO 9000:2015 indicating the third chapter of this standard *Terms and Definitions* as the limelight.

2. TERM FORMATION AND EXAMPLES OF TERMINOLOGICAL INCONSISTENCY IN THE FIELD OF MANAGEMENT

Management is a specialized subject field undergoing rapid development, thus in constant flow of newly emerging terminological units, very often representing the same concept by more than one term and consequently, often causing terminological confusion. New terms in Serbian are generated from (1) adopting terms from other languages, (2) accepting internationalisms or (3) transferring words from the language for general purposes (LGP) into terms (the process known as *terminologization*). It is not infrequent that a single concept and a single foreign term in Serbian have several alternatives, originating from different linguistic processes. Despite the obvious need for an organized and unambiguous system of terms for adequate professional communication in this subject field, the reality is undoubtedly chaotic. It seems necessary to establish methods for selection of the most appropriate term alternatives, and carry out systematic process of terminology standardization in professional communication. Jakić (2014) claims that the following terminological principles are applied in the process of management terminology standardization (pp. 94-103):
- Precedence of Serbian terms over loan terms,
- Precedence of Latin and Greek terms over English, French, German, etc.,
- Adaptation of terms on all linguistic levels (phonological, morphological, syntactic),
- Precedence of shorter loan terms over longer Serbian terms.

2.1. Precedence of Serbian terms over loan terms

Loan words have an obvious dominance in the Serbian language management terminology. Having that the development of every language domain is important for the general language development we suggest the use of Serbian words whenever and wherever possible. There is no reason for avoiding a Serbian term even when it is used in parallel with an internationalism (generally Latin or Greek word): e.g. *obim* instead of *volumen*, *nespojivost* instead of *nekompatibilnost*. Even in such cases, only the basic term is to be taken, but further derivations should follow the linguistic rules of Serbian. It is necessary to work on Serbian term formation systematically and continuously in order to create useable, useful, practical and linguistically correct terminology. Table 1 provides some Serbian management terms as examples of precedence over loan terms.

Table 1: Serbian management terms and their loan equivalents

Loan term or term with a loan element	Term in Serbian
Bridžing	*Premošćavanje*
Incidenca	*Pojava*
Prevencija	*Sprečavanje*
Kompetencija	*Konkurencija*
Border line	*Poremećaj, granični poremećaj*
Flow chart	*Dijagram toka*

2.2. Precedence of Latin and Greek terms over English, French, German, etc.

Jakić (2014) indicates that unlike other loan words, Latin and Greek easily find their place in the Serbian language system (p. 96). The experience of borrowing lexical items from these two languages is centuries-long and Serbian (as many other languages all over the world) has developed certain mechanisms for adoption and adaptation of Latin and Greek lexical materials. These internationalisms have secured themselves a special position within other language systems (including Serbian), so it is not always necessary to insist on finding a proper translation of a Latin or Greek term (or a term including their elements).

Table 2: Examples of diachronic development of words with Latin or Greek root

Term	Serbian	Latin or Greek root
Company	*Kompanija*	Latin words *fed up* and *panis*, *bread* combined give the root of a word *company*. At a later stage it started being used in a business context.
Cash	*Gotovina*	Derived from a Latin word for "box" *cassa*. At the beginning it was used by French and denoted "moneybox".
Consumer	*Potrošač*	Latin expression *consume* means "*eat it all*". This has led to the use of the term *consumer*.
Economist	*Economist*	Comes from a Greek word *oikonomia*, which means *house management*.

2.3. Adaptation of terms on all linguistic levels (phonological, morpho-syntactic)

Adaption of terms on the phonological level is obvious in translations. Phonological form of a translation should be defined by the pronunciation in a source language, its orthography and influence of the language mediator.

2.3.1. Phonological level

Several levels of phonological adaption (transmorphemyzation) of translated management terms could be noted (Jakić, 2014):

Table 3: Adaptation of terms on phonological level

Complete transformation	Phonemes of a source language are replaced with compatible phonemes of a target language with completely the same phonological description: - *AQAP (a ku a pe)* (Allied Quality Assurance Publications) - AQAP (ej kju ei pi); - *PDCA (pe de ce a)* (Plan-Do-Check-Act) - PDCA (pi di si ei);
Partial transformation	Phonemes of a source language are replaced with semi-compatible phonemes of a target language: - brainstorming - *brejnstorming*; - benchmarking - *benčmarking*; - reengineering – *reinženjering;*
Free transformation	Phonemes of a source language find neither complete nor partial compatibility in phonemes in a target language; as a result, they are replaced in a free form. - E- business - *E- biznis* - Brand management - *Brand menadžment*

2.3.2. Morpho-syntactic level

The level of morpho-syntactic adaption of translated terms is measured by the difference - similarity criterion in parts of speech that the term elements in both source and target language belong to.

Table 4: Adaptation of terms on morpho-syntactic morphological level

Brain + storming	*Moždana + oluja*
Bench + marking	*Tezga za rad + reperi*
Re + engineering	*Ponovo + inženjering*
Reverse engineering	*Unatrag + inženjering* ili *inženjering unatrag*

Lexical and semantic adaptation of borrowed and translated terms is related to lexical synonymy, translation pairs and definition or all those translations that show interlingual semantic changes between source and target equivalents. Here are some examples of management terms and their translation equivalent forms:

Table 5: Translation equivalents

ROA (return of assets)	*PS (povraćaj sredstava)*
VAE (value added per employee)	*DVPZ (dodata vrednost po zaposlenom)*
MS (market share)	*UNT (udeo na tržištu)*

2.3.3. Precedence of shorter loan terms over longer Serbian terms

Although we think that Serbian words and expressions should get the status of a term whenever and wherever possible, for the purpose of language economy many shorter loan terms should be accepted.

Examples:
- The term *mobing* (mobbing) is used instead of a longer expression in Serbian *zlostavljanje na radnom mestu*;
- The term *percipirani kvalitet* (perceived quality) instead of a *korisnikovo poimanje kvaliteta*.

Filipović and Đurić (2009) tried to find a terminological solution to the translation of the expression *5W2H* (*what, why, where, when, who, how, how much*) and they proposed seven standard questions asked in the quality planning. The reasons for the possible precedence of the first (English) terminological alternative over the suggested Serbian one may be the length and language economy. Almost all scientists, both linguists and subject field experts, Bugarski, (2007), Cabré (1999), Filipović and Filipović (1997, 1998), Milić (2013), Silaški (2009, 2012), Wright and Budin (1007) and Šipka (1998), are unanimous when it comes to some basic characteristics of scientific and professional terms. With certain differences, they all agree that a term should be (1) monosemous (have only one meaning), (2) non-synonymous, and (3) as short as possible.

3. ISO 9000:2015: SPECIFIC TERMINOLOGICAL ISSUES

We observed the following three terminological issues in the ISO 9000:2015 standard, namely:
- Terminological inconsistency;
- Terminological ambiguity;
- Terminological acronyms.

3.1. Terminological inconsistency: Use of *management + noun in the instrumental case vs. management + noun in genitive case*

By analyzing Serbian terms as used in this standard, we noticed the frequent use of the instrumental case in terminological expressions after the noun management. Table 7 presents examples of the terminological construction *management + noun in the instrumental case* as identified in SPRS ISO 9000:2015, together with their English equivalents. The numbers preceding the terms are their referent numbers from the standard.

Table 6: Terminological construction *management + noun in instrumental case*

Term in Serbian (SRPS ISO 9000:2015)	Term in English (ISO 9000:2015)
3.3.4 Menadžment kvalitetom	3.3.4 Quality management
3.5.4 Sistem menadžmenta kvalitetom	3.5.4 Quality management system
3.1.2 Konsultant za sistem menadžmenta kvalitetom	3.1.2 Quality management system consultant
3.4.3 Realizacija sistema menadžmenta kvalitetom	3.4.3 Quality management system realization
3.3.9 Menadžment konfiguracijom	3.3.9 Configuration management
3.3.12 Menadžment projektom	3.3.12 Project management
3.5.7 Sistem menadžmenta merenjem	3.5.7 Measurement management system
3.8.11 Plan menadžmenta projektom	3.8.11 Project management plan

The examples above point out that ISS apparently opts for the use of instrumental case following the term *management*. Namely, Technical Committees of the ISS are *Sistemi menadžmenta zaštitom životne sredine (Environmental management), Ocenjivanje usaglašenosti i menadžmenta kvalitetom (Conformity assessment and quality management), Sistemi menadžmenta bezbednošću hrane (Food safety management systems)* and all of these contain the same construction: *management + noun in instrumental case.*

Unlike the translation of the original ISO standard terms done by the members of the working committee within the Institute for Standardization of Serbia, management experts that belong to Serbian academic community unmistakably insist on the use of genitive case (*management + noun in genitive case*). This is obvious in the names of courses and study departments at universities. For example, the Faculty of Organizational Sciences in Belgrade, as the institution of the supreme authority in management studies has a department named *Menadžment kvaliteta i standardizacija* (Quality management and standardization) and among numerous courses offered by the Faculty, we can find *Menadžment ljudskih resursa* (Human Resource Management), *Menadžment tehnologije i razvoja* (Technology and Development Management), *Menadžment inovacija* (Innovation management), *Sistem menadžmenta kvaliteta* (Management quality system) (Jaško and Petrović, 2009). Following the given examples noticed in the Serbian academia, we can conclude that the forms of the previously listed terms from the standard should be like those given in the Table 7.

Table 7: Terminological construction *management + noun in genitive case*

Term in Serbian (SRPS ISO 9000:2015)	Term in English (ISO 9000:2015)
3.3.4 Menadžment kvaliteta	3.3.4 Quality management
3.5.4 Sistem menadžmenta kvaliteta	3.5.4 Quality management system
3.1.2 Konsultant za sistem menadžmenta kvaliteta	3.1.2 Quality management system consultant
3.4.3 Realizacija sistema menadžmenta kvaliteta	3.4.3 Quality management system realization
3.3.9 Menadžment konfiguracije	3.3.9 Configuration management
3.3.12 Menadžment projekta	3.3.12 Project management
3.8.11 Plan menadžmenta projekta	3.8.11 Project management plan
3.5.7 Sistem menadžmenta merenja	3.5.7 Measurement management system

There is an obvious lack of communication and cooperation between the Institute for Standardization of Serbia and the academic community, resulting in a discrepancy between the term variants adopted by the national standards and the national educational system. The first ones are primarily used by current management experts working in different fields. The second ones, however, are preferred by the educational system which prepares future experts and provides them with terminological knowledge. It is clear that both sides share responsibility for the state of terminology of the subject field.

3.2. Terminological Ambiguity

Jakić (2014) draws attention to the frequently occurring incorrect translation of the English terms (p.102):

- Control vs. Inspection;
- Interested parties vs. Stakeholders

3.2.1. Control vs. Inspection

The term *control* is repeatedly translated into Serbian as *kontrola* or *kontrolisanje* while the meaning of the concept that it denotes in Serbian is *upravljanje*. Even in scholarly articles on management, *quality control* is often transferred into Serbian as *kontrola kvaliteta*, but its correct translation is *upravljanje kvalitetom*. SPRS ISO 9000:2015 clearly confirms this fact, so it offers the following terms: *3.3.7 upravljanje kvalitetom* (*quality control*) and *3.3.10 upravljanje izmenama* (change control). The mentioned errors are the consequence of the negative transfer from English. Both, *kontrola* and *kontrolisanje* are two expressions for the same concept and its English equivalent is *inspection*. It is interesting that SRPS ISO 9000:2015 chooses only *3.11.7 kontrolisanje*, even though *kontrola* is used more often in the professional communication. Since these terms are synonyms and the one out of the standard is more frequently used, perhaps its introduction into the standard should be considered.

3.2.2. Interested party and stakeholder

The terms are seen as synonyms and defined as *"a person or organization that can affect, be affected by, or perceives to be affected by a decision or activity*" (ISO 9000:2015). SRPS ISO 9000:2015 also equates terms *zainteresovana strana* (*interested party*) and *interesna strana* (*stakeholder*). Jakić (2014) underlines that their synonymous relationship should be reconsidered and underlines the need for correct understanding of their definitions (p.102).

3.2.3. Terminological Acronyms: QMS or SMK

Throughout the Serbian version of the standard ISO 9000:2015, the English acronym *QMS* (S*istem menadžmenta kvaliteta)* is used. The English acronym *QMS*, though not adapted to the Serbian phonological system (i.e. it contains an element – letter Q – which is not a part of the Serbian alphabet), does accept our flective suffixes (e.g. *QMS-om, QMS-u*, etc.). Having that one of the main terminological principles is that a source language (English) term should be fully adapted to the linguistic system of a target (Serbian) language (explained in more detail in 2.3. above), our main concerns regarding this issue are whether:

(a) the acronym should be phonologically adapted (through the process of transphonemyzation)
(b) the acronym should be adapted on lexico-semantic level, i.e. whether it should be replaced by a Serbian alternative: *SMK* (*Sistem menadžmenta kvaliteta) instead of QMS .*

The same process of adaptation could be applied to the acronym *DRP* (for *Dispute Resolution Process*) used in ISO 9000:2015. This acronym is used in unadapted form in the Serbian standard to mark *Proces rešavanja spora* instead of the possible alternative (PRS).

A very common deviation from the Serbian language norm is the disregard of the Serbian word order in noun phrases. Namely, the replication of English word order in Serbian noun phrases, especially when the first element of the noun phrase is a/an (foreign) acronym: *QMS model, QMS standard, DRP isporučilac*, etc. The Serbian alternatives to these terminological phrases would be (*model QMS*-a) or (*model SMK-a)*, see 3.4. above), (*standard QMS-a) or* (*standard SMK*-a), (*isporučilac DRP*-a) or (*isporučilac PRS-a*).
By following the English word order, Serbian terminological noun phrases also avoid using the flective suffixes, which does contribute to language economy, on the one hand, but also breaks the Serbian language norm, on the other hand.

4. CONCLUSION

The terminological issues addressed above raise several questions:

Namely, the first one is whether the translation of the ISO 9000 standards is adequate enough, i.e. whether the terms present in the standards can actually be regarded as the most representative ones and acceptable both from the perspective of Serbian language standard and the perspective of the subject field experts.

Secondly, there are some inconsistencies between term variants preferred by the Institute for Standardization of Serbia and the ones present and transferred into our educational system. This obviously stipulates close cooperation between the standardization institutions and relevant expert institutions (primarily educational). Before the adoption, all Serbian standards are accessible to the public and can be a

subject of public hearing. As long as a national institution specialized in terminological activities is not established, the existing relevant bodies should actively participate in this field.

In conclusion, one of the preconditions for monosemous and harmonized terminology should be good terminology management (Galinski, 1999), i.e. a systematic approach to all terminological activities, and especially to its standardization, as well as and a close cooperation between linguists, terminologists, and subject field experts.

REFERENCES

Bugarski, R. (2007). *Lingvistika u primeni*. Beograd: Čigoja štampa.

Cabré, M. T. (1999). *Terminology: Theory, Methods and Applications*. Amsterdam: John Benjamins Publishing Co.

Filipović, J., Đurić, M. (2009). *Osnove kvaliteta*. Beograd: Fakultet organizacionih nauka.

Filipović, J., Filipović, J. (1997). General Trends in Standardization of Scientific Terminology in Serbian: A Critical Analysis of the State of Affairs. *International conference on terminology*. Donostia – San Sebastian, Spain., 285-291.

Filipović, J., Filipović, J. (1998). Uloga standardizacije terminologije u tržišnoj privredi. *Menadžment totalnim kvalitetom,* vol. 26, br. 1, 47-50.

Galinski, C. (1999). Terminology Infrastructure and Terminology Market in Europe. In Szabó, K. (ed.), *Knowledge Transfer in the Information Age*. Budapest: National Committee for Technological Development (OMFB), 78-85.

Jakić, G. (2014). *Terminologija organizacionih nauka*. Beograd: Fakultet organizacionih nauka.

Jaško, O., Petrović, D. (eds). (2009). *Leksikon pojmova za pripremu prijemnog ispita za master studije*. Beograd: Fakultet organizacionih nauka.

Milić, M. (2013). Stvaranje, standardizacija i kodifikacija sportske terminologije u srpskom jeziku. U: Silaški N. & T. Đurović (eds.) *Aktuelne teme engleskog jezika nauke i struke u Srbiji: tematski zbornik radova*. Beograd: Centar za izdavačku delatnost Ekonomskog fakulteta u Beogradu, 79-89.

Silaški, N. (2009) Ka standardizaciji terminologije u oblasti marketinga i menadžmenta. *Ekonomske teme*. XLVII: 111- 125.

Silaški, N. (2012). *Srpski jezik u tranziciji: o anglicizmima u ekonomskom registru*. Beograd: Centar za izdavačku delatnost Ekonomskog fakulteta

Šipka, D. (1998). *Osnovi leksikologije i srodnih disciplina*. Novi Sad: Matica srpska.

Wright, S. E., G. Budin (1997). *Handbook of Terminology Management -Volume 1: Basic Aspects of Terminology Management*. Philadelphia, USA: John Benjamins Publishing Company

QUALITY COSTS IN THE MANAGEMENT SYSTEM IN THE FIELD OF HIGHER EDUCATION

Nedeljka Zivkovic[1]
[1]Belgrade Business School, HigherEducation Institution for Applied Studies
*Corresponding author, e-mail: nedeljka.zivkovic@yahoo.com

Abstract:*The topic of this paper belongs to the research field of the significance of quality costs, that is, non-economic costs, applied to institutions of higher education, and its specificity lies in differentiatingand considering actual costs and lost opportunities costs, which, as a rule, are significantly higher. Measuring and identification of quality costs is a complex process because these costs are, as a rule, hidden and not represented as actual costs, rather aslost opportunities costs. The aim of this paper is to consider and interpret quality costs applied to a higher education institution, to show the need to invest resources in support costs of introducing and implementing quality systems, considering and assessing the possibilities of lowering quality costs as opportunity costs,correlated with considering lost opportunities costs, quality and total benefit, should these costs not be incurred. The identification and consideration of total quality costs and their division into categories are presented as costs actually incurred by missing to invest an asset as real costs of current operations.*

Keywords*:costs, quality, higher education, students, investments*

1. INTRODUCTION

The starting point for the quality costs is determined and generally accepted amount of costs for the implementation and application of the quality system which serves as the basis point, and is necessary for higher education institutions to be able to decide about the acceptability of the amount of initially actually incurred quality costs with consideration of the consequences presented through the measurement of the scope of potentially incurred of costs due to the failure to implement the quality system.*Filipović and Đurić (2010, p. 384) point out thatquality costs are defined as "costs incurred in an organization in order to secure the quality of the product".*The optimization of quality costs in higher education institutions is based on the increase of quality costs manifested through investments into prevention, consequently leading to a decrease of costs which can occur due to failure to implement quality and the total implementation costs and application of the quality system. *Summers (2009, p.270) points outthat "using quality costs, a manager can determine the usefulness of investing in a process, changing a standard operating procedure, or revising a product or service design".*The optimization of quality costs is a process of balancing the quantity of resources used to insure the level of quality, which means to fulfill the user's request. Unlikethe actually incurred costs resulting from the functioning of a higher education institution, and unavoidable in all organizations, therefore also in higher education institutions, the actual quality costs are difficult to identify and locate. The actually incurred costs resultingfrom the business operations activities represent the actualization of business policies set by the management of the higher education institution in the planned annual budget in terms of types of costs and their scope, adhering to the following goals:

- Preserving the financial strength through the scope of assets engaged and sources available for financing, while defining the business policy of preserving permanent payment ability, permanent financing ability, that is, investing in the development and modernization of equipment and assets for the realization of the teaching process;
- Preserving assets and increasing assets;
- Maximizing the financial result, as the highest long-term goal, and
- Permanent ability to pay salaries and encourage employees, the ability to settle liabilities to creditors on time, as well to state bodies and organizations.

Quality costs in all organizations, as well as in higher education institutions, are defined as hidden costs which wouldn't be incurred if everything were done correctly the first time, that is, if the product/services were always without errors. Objectively, this is impossible. So, quality costs or bad quality costs are actually costs of lost opportunities. All quality costs incurred occur due to incorrect process performance and are measured as costs incurred or which shall incur above the initial investment costs in the quality system being applied. Organizations measuring their costs discovered that the situation in certain institutions is such that total quality process costs can make up to 30% of total sales, which is an extremely high scope of costs. *Pyzdek and Keller (2013, p. 22) point out that "the lower cost of quality than competitors, translates to lower overall*

*cost".*There are situations when the costs caused by not applying the quality system are two to three times higher thanthe potential gain, so that the decrease of costs which are in correlation with the quality systems can influence the operational profitability and increase the profitability rate as the measure of operational yield. Hence, quality costs are costs incurred if each activity in the organization is performed correctly each and every time. Initial quality costs in higher education institutions consist of all that was invested in the implementation and application of the quality system and they are part of the primary costs, but all that was lost or can be lost due to bad quality makes for the secondary part of costs caused by failing to apply or the untimely application or implementation of quality in business processes. In higher education institutions these costs can be qualified as loss of accreditation costs, transfer of students to other faculties, inadequate choice and calibration of the teaching program, incomplete teaching performance and such. Seemingly these costs do not exist. However, the analysis of the gain lost, as a rule,in the long-term quantifies the amount of lost opportunities costs – quality costs.

2. QUALITY COSTS STRUCTURE

In the structure of total costs there is a certain amount we call primary quality costs. Those are the costs an organization incurs in order to achieve the aimed quality. Quality costs can be defined as costs incurred by activities (primary costs), costs referring to the prevention of errors (accompanying costs) and lastly, secondary costs incurred by failing to apply the quality system entirely or partially, or as a consequence of making errors arising from the non-compliance to the determined procedures and processes. The most significant characteristics of quality costs are:

- Initial or primary–accompanying quality costs;
- Secondary costs or costs arising by failing to apply or applying inadequately the quality systems; these costs are hidden as a rule;
- They are contained in the financial statements, not as separately presented items of current costs in the income statement, rather as opportunity costs of decreased utility (revenue);
- As a rule, their structure is not obviously known, but they can be identified;
- They are missed, potentially unexploited chances of possible, lost profit;
- The degree of knowledge about these costs is a measurement of the degree of awareness about the quality;
- As a rule, these costs are significant in scope. Although hidden, they must be identified by the management in order to take steps to decrease them or eliminate them through intensive monitoring of the quality application (hotspots of cost – loss incurrence);
- Due to their specific nature manifested in a hidden – opportunity effect, these costs can be latently very high and significant for survival and development.

Evans and Lindsay (2002, p. 408-412) mention that the termquality costs first appeared in the 1950s.
Quality cost structure can be presented as follows:

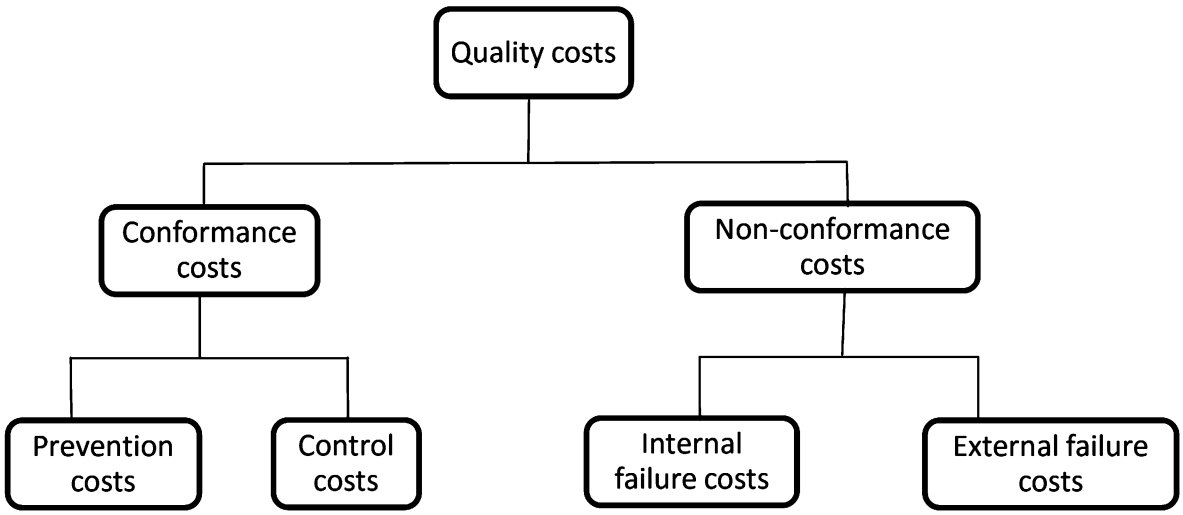


Figure 1: Outline of the quality costs

Charantimath (2011, p. 14)states that "cost of quality has two main components – cost of conformance and cost of non-conformance".When the term cost is mentionedin this case, it refers to the failure to satisfy the user's requests. Costs of not applying quality are, as a rule, very high and should they be incurred they are manifested and significantly influence the direct decrease of profit though revenue lost and performance lost. For this reason, top management takes all measures and activities to identify bottlenecks and reasons for hold-ups in the application of the quality systems and measures which will in the shortest period possible effectively remove the problems identified.

2.1. Prevention costs

Prevention costs are costs of all activities undertaken in order to stop the occurrence of non-conformities. In higher education institutions prevention costs would be identified as:

- Educational services and employee education;
- Participation fees for educational seminars;
- Participation fees for professional training;
- Participation at fairs and symposiums;
- Literature and professional examination expenses;
- Other professional education expenses.

Douglas (2013, p. 33) discusses that the application of prevention costs could be unclear. These costs are desirable but they must be directed where they are most effective and can decrease other undesirable quality costs. Prevention begins with market research, that is, the understanding and complying with the users' needs, as well as expectations. These costs are also called conformance costs in the literature. They include all techniques and measures preformed in order to prevent errors. Error prevention costs are proportionate to the cost of removing errors in accordance with the rule "1:10:100". The rule "1:10:100" basically means that the removal of errors during the planning process costs 10 times more, and the removal of errors during the realization process costs 100 times more than the prevention of errors. Applied to higher education institutions in the process of gaining accreditation it would mean that if the prevention of an error costs one monetary unit, the correction of the error during the review of accreditation documentation costs 10, and the correction after the documentation was returned by the accreditation committee costs 100 monetary units. Prevention costs are several times lower than correction costs incurred due to non-conformity. These costs can be regarded as an investment in quality.

2.2. Assessment costs

Assessment costs are the costs of measuring and rating quality conformance along with the costs of research and control.*Quality assessment costs in the words of Živković and Glogovac (2015, p. 158) are "initial assessments in relation to the quality which are not based on experience, rather on assumptions"*.They are the costs incurred in the adjustment of the degree of conformity to the quality requests, such as:

- Incoming control and testing;
- Control and testing of the process;
- Final control and testing;
- Monitoring service quality;
- Maintenance of research equipment and software;
- Control and testing of material and services and
- Valuation of inventory.

Filipović, Đurić and Teodorović (2008, p. 1) point out that „the education is a specific, but also a classic service activity".One of the most important differences between education and production (and other service activities) is that here we find an intensive and permanent interactive role between the user and the provider of the service. In higher education institutions these costs may be identified in the field of testing the achieved level of quality of service provided to the students.
Within them the following can be identified:

- Testing and monitoring the curriculum;
- Monitoring the work of all departments (student administration, accounting...)
- Monitoring the work and work quality of teachers;
- Testing by applying a trial classification exam;
- Surveying the students.

2.3. Costs of non-conformities

Costs caused by errors are referred to as non-conformities costsin literature. These costs include all direct and indirect costs in relation to the correction of errors of any type, wherever they occurred. The mentioned errors include all accidental and system errors occurring in organizations. The majority of costs for the correction of errors directly depend on the location and scope of their influence on the application of quality, after their identification. The later the error is detected, the higher the costs. Non-conformancecosts occurwhen the quality system is not applied and due to the unsuitability of the quality system. In higher education institutions these costsare identified when students are lost, that is, when they transfer to other faculties due to their dissatisfaction; they can also bebased on the loss of accreditation due to non-compliance with certain requirements such as the number of teachers necessary for a quality performance of classes and exercises in relation to the number of students, existence of adequate space for the delivery of classes (necessary number of classrooms, laboratories and lecture halls). Depending on where the non-conformanceis identified, that is, within the organization itself or externally, we differentiate between internally detected and externally detected non-conformities.

2.3.1 Costs of internal non-conformities

Costs of internal non-conformities or internal errors comprise those costs that have not fulfilled users' requests and have been detected within the organization itself. These costs include:

- Write-offs, badly provided services;
- Reprocessing, that is, the need to provide the service again;
- Costs of lower level quality ;
- Reexamination.

Applied to higher education institutions these non-conformitiescosts refer to cases when, for example, during the exam registration in the current examination period, the wrong exam was registered for a student by the administrative worker in the student administration, or during the change of the study program, a student was enrolled to a wrong study program due to an error of the administrative worker.*Ušćumlić andLukić (2008, p. 214) state that internal costs of failures are redundant, that is, they do not lead to the increase of the value of output, and they contain: costs of corrective actions or measures, costs of re-inspecting and re-examining, costs of repeat work and such.*

2.3.2 Costs of external non-conformities

Costs of external non-nonconformitiesoccur when a product or a service reaches the user, that is they leave the organization, and they do not conform to the user's request. These costs include:

- Costs incurred from processing appeals and objections;
- Costs incurred by processing and conducting a litigation;
- Costs of recalls and liabilities;
- Corrective actions;
- Costs of realized warranties;
- Liability costs;
- Examining objections.

During the reporting of non-conformities it is necessary to define the cause of error and to make a decision about the application of measures to remove the identified non-conformities. External costs of non-conformities decrease the profitability of the organization. External failure costs take up a considerable share of total costs. This can be presented in the following way using an example of investments in prevention in a higher education institution:

Table 1: Review of quality costs based on investments(in 000 of dinars)

Investments	I period*	II period	III period
Net monetary investments	50.000.000	80.000.000	120.000.000
Effectsof investments	90.000.000	130.000.000	150.000.000

*period of one accreditation or 5 years

As in all organizations, in higher education institutions investments are necessary in order to deliver education of "the best quality product" and the most significant resource of a higher education institution

efficiently in accordance with the set quality standards. Consequences of not caring about the application of the quality system and managing quality costs are, as a rule, unrecoverable, considering that their occurrence is measured with the opportunity loss of expected gain. They are presented as:

- Loss of accreditation;
- Transfer of students to other higher education institutions;
- Bad reputation and a decrease of the enrollment interest of prospective students ;
- Poor rating, etc.

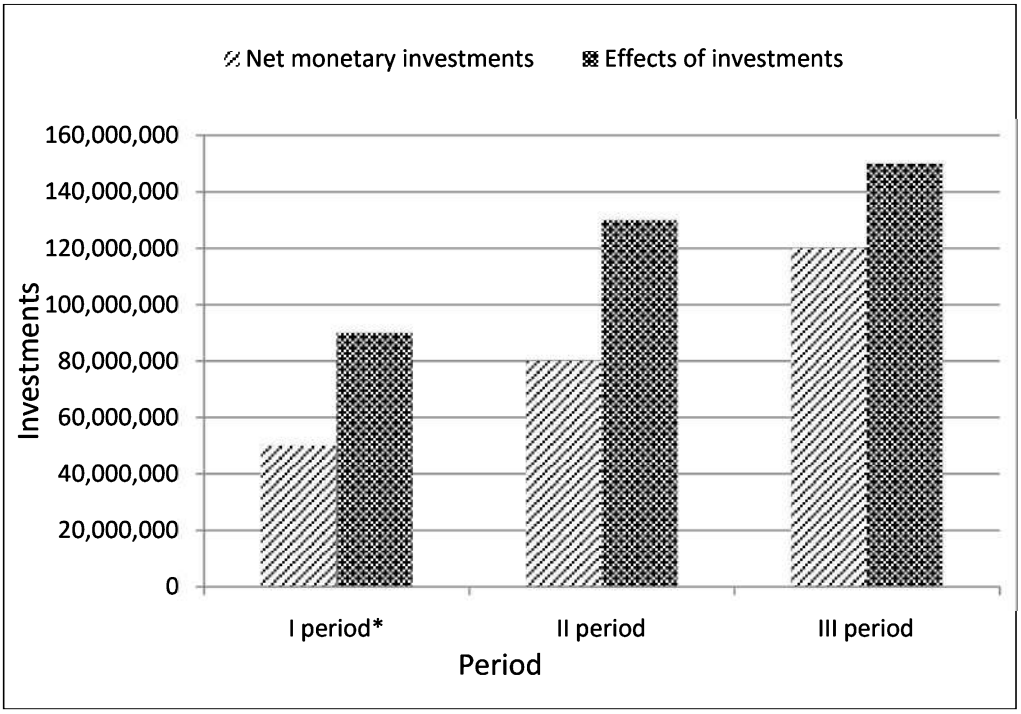


Figure 2: Graphicalview of quality costs (in 000 of dinars)

The table and graphical view clearly show that the investment in costs, that is, net monetary investments, produces the effects of those investments. The breakdown of investment costs would be as follows:

- Investments in IT support,
- Investments in software (software adjustments),
- Investments in furnishing,
- Investments in human resources (teaching and non-teaching employees).

3. AIMS OF QUALITY COST ASSESSMENTS

*Drury (2015, p. 48) points out that the present business conditions where the only thing that is constant is change, there is a general agreement in business practice that costs, quality, time and innovation are key variables to achieve user satisfaction.*Striving to developa concept of managing quality costs, as comprehensible as possible, has resulted in the creation of numerous concepts aimedat decreasing both quality costs and total costs.

Juran and Gryna (1999, p. 20) emphasizethatall organizations assess quality costs for several reasons.

- Quantifying the size of the quality problem expressed through the measurement of money – improving communication between middle and senior management. At some organizations the need to improve the communication between the levels of management is so present that it has become the main topic of the case studies about bad quality. When preparing case studies, assessment of quality costs is significant for two reasons: first, quality costs have shown to be much higher than managers and management assumed, and second, while the allocation of quality costs confirms some known problems, it reveals other problematic areas previously unknown.
- Major opportunities to decrease costs could be recognized. Bad quality costs do not exist as a homogenous mass. In reality they consist of a whole of specific segments, each of which can be identified, as well as their cause. When assessing bad quality costs the most important thing is to recognize segments directly causing bad quality.
- Opportunities can be recognized for decreasing user dissatisfaction and dangers related to the realization of products or services. Some bad quality costs are the result of management omissions.

Viewing and assessing the costs can help recognize vital areas of high costs. With total view of all business success markers of an organization there is a realization not only about the quality costs, but also about total costs in an organization. Quality costs assessment in higher education institutions is identified through managing and monitoring quality costs of all business processes, monitoring the work of all departments (student administration as an important process with a direct relation to the users - students), then the accounting department as the financial department performing indirect work with students though analytical monitoring of settling student obligations, while Departments assume a special place, and in accordance with the study programs, they professionally coordinate and monitor the delivery of classes, at the same time analyzing all quality segments and processes of monitoring the functioning of the teaching process, the basis of higher education work.

4. COMPARING QUALITY COSTS WITH BUSINESS MARKERS

Understanding the total amount of costs is made easier by comparing total quality costs with other markers presented to management. Markers with the highest influence on higher management are:

- Quality costs as realization percentage (revenue),
- Quality costs compared to net gain,
- Quality costs as a share in total realization costs,
- Influence of quality costs on the cost-effectiveness threshold (yield).

If we take the example of an organization such as a higher education institution, primary quality costs measured according to their size in relation to revenue, yields or their share in total costs aren't a true measurement of quality costs, because we have determined that quality costs represent opportunity costs of missed uses and as such can be extremely high and are not measurable and comparable with costs, revenues, gain, etc. of a certain period.

5. QUALITY COST ANALYSIS

Analyzing interrelations of quality costs leads to different understandings. Studies in many organizations about quality control show that omission costs surpass assessment costs. If management becomes aware that prevention costs are extremely low, this would alarmingly mean that non-conformance and omission costs will be high. In order to achieve a significant decrease of quality costs, one must take control of the assessment costs. An increase in prevention costs can bring gain to the later decrease of costs. *Filipović and Đurić (2010, p. 409) point out that, "if it turns out that the highest percentage of costs belongs to non-conformance,then the management is spending money on the wrong things".*This mostly refers to production organizations, but below is an attempt to apply it to a service organization. A higher education service institution functioning on a state level wants to improve the quality of services to its users – students through both teaching and non-teaching processes. Top management of the higher education institution is familiar with the work and functioning of other faculties and colleges and has come to the knowledge that it could decrease non-conformance costs. Gathering data on an annual level in the cost analysis per categories is presented in the following table:

Table 2: View of quality cost control analysis per category

Purpose of quality expenses	Annual costs (in m.u.)	Quality cost category
Errors in printing forms – for keeping students register	11	Internal non-conformance
Training costs	40	Prevention
Complaints – student's exams were not registered due to a clerk's error	8	External non-conformance
Testing regularity of classes	70	Assessment–testing

After identifying individual costs and determining to which category they belong, a sum and percentage review was made and is presented in the following table:

Table 3: Quality cost analysis per category

Quality cost category	Amount (inm. u.)	Percentage in the total
Total prevention costs	40	31%
Total assessment costs	70	54%
Total costs of internal non-conformance	11	9%
Total costs of external non-conformance	8	6%
Total	129	100%

Based on the datapresented in the table, one can draw the conclusion that it would be advisable for top management of the higher education institution to spend more money on investments in prevention in order for quality costs of the control and examination to decrease. Costs of internal and external non-conformities are low which is certainly a good result; it would be even better if the costs of prevention which amount to 31% were much higher on account of assessment costs. If we assume that an inadequately prepared teaching process and insufficient, that is, inadequate number of teaching staff necessary to deliver classes, in accordance with the Bologna convention in higher education institutions (HEI) which fails its accreditation in one out of five parts of up until now accredited teaching processes (study programs), quality costs will influence the decrease of the direct revenue of HEI in the next five years in the level of enrollment fees of self-financed students increased for the accompanying studying revenue (exam registration, semester registration, etc.) in the amount of 90.000 RSD annually for approximately 150 students. Aside from the direct loss of the period, indirect loss will be identified as the loss of the period due to the withdrawal of prospective students from studying at the higher education institution due to bad acquisition image entirely determined by the loss of one study program. That loss is assessed to about 80 students annually.

Loss without one program accredited:

I year:	150+80=230 x 90.000=	20.700.000 RSD
II year:	150+80+105 (70% transfer from first of 150 students) = 305 x 90=	30.150.000 RSD
III year:	150 +80 + 75 (50% transfer from II into third year)= 305x90=	27.450.000 RSD
IV year:	150 + 80 + 75=	27.450.000 RSD
V year:	150 + 80= 230 x 90.000 RSD = 20.700.000 + loss of the next three years until the enrollment (9.450.000+6.750.000+6.750.000) =	43.650.000 RSD
TOTAL:		**149.400.000 RSD**

Projection of HEI revenuewithout the loss of accreditation for one study program:

I year:	1.200 students (5 departments – study programs x 90.000) =	108.000.000 RSD
II year:	1.200 +840 (70% from1.200)=2.040x90.000=	183.600.000 RSD
III year:	1.200 +600 (50% from 1.200) = 1.800x90.000=	162.000.000 RSD
IV year:	1.200+600=1.800 x 90.000=	162.000.000 RSD
V year:	1.200x90.000=	108.000.000 RSD
TOTAL:		**723.600.000 RSD**

Table4: Review of revenue decrease

Year	Total revenue (without loss of the accreditation)	Revenue (without accreditation of one program)	Difference – revenue
I	108.000.000	20.700.000	87.300.000
II	183.600.000	30.150.000	153.450.000
III	162.000.000	27.450.000	134.550.000
IV	162.000.000	27.450.000	134.550.000
V	108.000.000	43.650.000	42.570.000
TOTAL:	723.600.000	149.400.000	552.420.000

Graphically it can be presented in the following way:

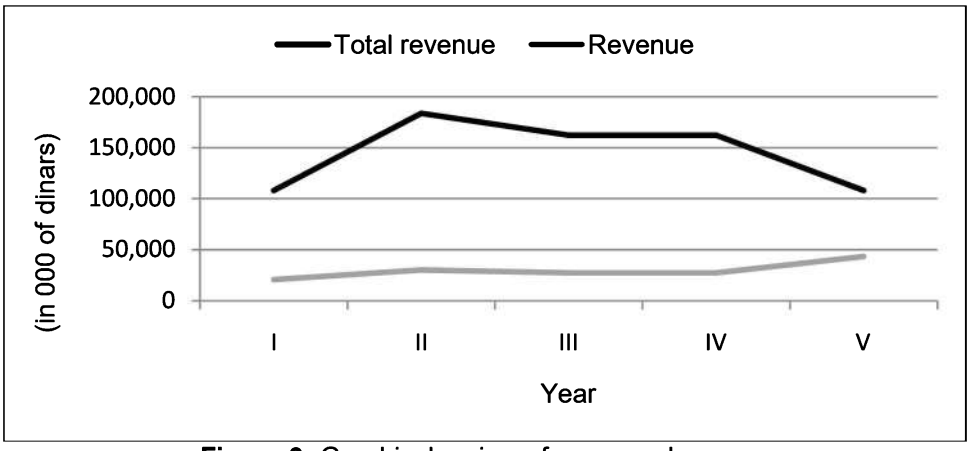


Figure 3: Graphical review of revenue decrease

The example shows that quality costs manifested as opportunity costs of revenue decrease due to insufficient application of the quality system significantly influence the decrease of revenue from HEI during the accreditation period (five years). Their average share in revenue decrease in the observed period is 21% or on an average RSD 29.880.000.

6. QUALITY COSTS DECREASE

*Total quality costs can be significantly decreased with reallocation.Uščumlić and Lukić (2016, p. 143) point out that "the higher level of quality decreases total costs".*The increase of prevention and control costs influences the decrease of costs of both internal and external non-conformities. Costs in relation to bad quality are present both because of occasional and permanent problems with quality. Constant improvement (called Kaizen by the Japanese) is necessary, as well as constant efforts in order to improve all processes within organizations. *Goetsch and Davis (2016, p. 19) indicate that"reducing the costs associated with poor quality is mandatory for companies that hope to complete in the marketplace. Reducing such costs is one of the principal drivers behind the total quality concept of continual improvement".*Financial markers and financial measurements are usually critical because they sum the economic influence of different physical activities in a manner understandable to managers, although the way of financial presentation might not correspond to the actual flow of economic events. On the other hand, financial accounting requires exclusively financial markers. Quality costs consist of financial costs during the process of introducing and monitoring quality systems. While the quality functions, those costs are correlated with other costs and revenue as measurements of success during the work of the period. However, missing the application of quality entails missing the primary cost of applying, controlling and monitoring in the current period which will be presented as a significant cost in the future periods, and not as current costs, rather as the opportunity costs of lost opportunities – unrealized gain, volume of business, references etc.; these costs are immeasurably higher and difficult to recover. When it comes to quality costs it is very difficult to find the right mix of financial and non-financial measurements to satisfy expected financial revenue and reconcile requests and effects of business decision makers. Lowest quality costs are those that maximally invest in quality.

7. CONCLUSION

Specificity of quality costs research applied to higher education institution as a service organization makes them objectively hard to divide between internal and external non-conformities because the largest part of quality costs in service organizations is related to the work of employees and the level of quality system application on that organizational level, so that internal non-conformance immediately becomes external in relations with the users – students. They are investment costs applied to the quality system. As to whether their amount is objective, the answer lies in the analysis of quality functioning. Costs of quality omission are not operational costs presented as direct costs in the income statement. This type of costs is presented as opportunity costs of missing on a chance of achieving revenue or some other type of benefit in the long-term period. Due to this, their amount is disproportionately high and significant. The paper pointed to the significance of quality costs or costs due to bad quality manifested in unrecoverable consequences such as loss of accreditation, if we take the example of a higher education institution which doesn't have space equipped to perform classes or has insufficient expert and competent teaching staff teaching and holding

classes. Then the cost of opportunities lost refers to the next five years, until the new accreditation, and the consequences are considerably higher, which is the measurement of the value of lost quality application costs. A complete overview and understanding of the bad quality costs is important and if every product (printing books and forms) or service were perfect, than these costs would be eliminated.

REFERENCES

Charantimath, P., M., (2011). *Total quality management*(2nd ed.). Delhi: Pearson.

Douglas, C.,Wood., (2013). *Principles of Quality Costs* (4th ed.). Milwaukee: ASC Quality Management Division.

Drury, C., (2015). *Management and Cost Accounting* (9th ed.).London: Thompson.

Evans, J., R., Lindsay, W.M., (2002). *The Management and Control of Quality*(5th ed.). South Western: Cincinnati.

Filipović, J., Đurić, M., &Teodorović, A., (2008).Menadžment i kvalitet u obrazovanju.Kopaonik: 56. Naučno-stručni skup psihologa Srbije *Razvoj i standardizacija u psihologiji.*

Filipović, J., &Đurić, M., (2010). *Sistemmenadžmentakvaliteta.* Belgrade: FON.

Goetsch, L., D., & Davis, S., B., (2016). *Quality Management for Organizational Excellence* (7th. ed.).New Jersay: Pearson.

Pyzdek, T., & Keller, P., (2013). *The handbook for Quality Management*(2 nd. ed.). Columbus, Ohio: McGraw Hill.

Summers, D., C., S., (2009). *Quality management creating and sustaining organizational effectiveness* (2nd. ed.). Columbus, Ohio: Pearson Prentice Hall.

Juran, J.,M., &Gryna, F., M., (1999). *Planiranje i analizakvalitete.*Zagreb: Mate.

Ušćumlić, D.,&Babić, J., (2016). *Kvalitet i menadžmentkvalitetom*.Belgrade: Ekonomskifakultet.

Ušćumlić, D., *Troškovi kvaliteta*. (ppt), (2016). Retrived from http://www.ekof.bg.ac.rs

Ušćumlić, D., &Lukić, R., (2008). *Upravljanjekvalitetommaterijalnihproizvoda.*Belgrade: Ekonomskifakultet.

Živković, N., &Glogovac, M., (2015). *Upravljanjekvalitetom.*Belgrade:FON.

DOCUMENTING PROCESSES: CHALLENGES FOR FIRMS OPERATING IN SERBIA

Marina Momčilović*[1], Ivan Stefanović[2]
[1]Junior Business Process Analyst, CCBill SRB doo
[2]Business Processes and Procedures Department Head, Vojvodjanska Bank ad Novi Sad
*Corresponding author, e-mail: marinam@ccbill.com

Abstract: *In general, managers in firms operating in Serbia do not have a proper knowledge on how processes ought to be documented in order to achieve high level of process standardization and, as a result, to create opportunities for increasing process performance. With this fact in mind, the authors of this paper set out to show the importance of this problem, hoping to raise awareness about the overwhelming space for significant improvement of business results in this area. For this purpose, insights on challenges facing three firms operating within different industries in Serbia are presented. Each of them, dealing with its own problems of document management system and process management, bears some sort of resemblance with the other two when it comes to challenges of documenting processes. The paper ends with practical guidelines for managers on how to properly document the processes within their firms in order to achieve benefits of process standardization and performance improvement.*

Keywords*: document, process, standardization, performance, firm*

1. INTRODUCTION

Establishing highly efficient processes within a firm and making them run smoothly is not an easy task to master, but this has become a necessary condition for all firms trying to prosper in contemporary business environment. In order to achieve high degree of process efficiency, firms must carry out their operations in a consistent manner, which is achieved through process standardization.

Standardization may be seen as the degree to which work rules, policies and operating procedures are formalized and followed (Jang and Lee, 1998), while standard represents an approved specification of a limited set of solutions to actual or potential matching problem or a time-wise frozen end product of a standardization effort (Vries 1999). When process is standardized, variations in performing tasks within it are reduced to a minimum, i.e. each task performed by a different employee gives the same results. Standardizing a process requires process participants first to gain sufficient understanding of the process, and only then to start developing accompanying documentation that will describe the process in sufficient level of details.

Therefore, in order to achieve high level of process standardization and, as a result, to create opportunities for increasing process performance, firms must get to know and document all of their processes in a proper way (cf. Teece, 1998). It is well known that use of process documents can improve the output consistency, efficiency, and learning rate of a given process (Edelson & Bennett, 1998; Monden, 1983; Suzaki, 1993). While on the one hand standardizing business process variants across their functional and geographical structures is very attractive for organizations for a number of reasons, on the other hand, over standardizing business processes might actually decrease the aimed advantages and prevent meeting local requirements with the rolled out standardized processes (Mustermann, 1976).

Despite its great importance for contributing to firm competitiveness, there is an evident lack of papers on standardizing and documenting processes (cf. Ungan, 2006a). Therefore, this paper is a small attempt to fill this void.

The paper starts with theoretical background explaining contemporary issues in documenting processes within firms. It continues with illustrating the challenges of documenting processes at three firms in Serbia operating in different industries. Finally, recommendations for practitioners working in Serbia are provided along with some concluding notes.

2. THEORETICAL BACKGROUND

The origin of documenting processes can be traced back to Frederick Winslow Taylor and his concept of scientific management (Taylor, 1911/1998). Taylor believed that workers were incapable of designing efficient processes, hence the need of management to develop documents describing how the work is to be done. The objective of documents under Taylorism was to have industrial engineers determine 'scientifically' the 'optimal' way to perform a given process.

The way in which process documents are developed and used today has changed radically. Best practice of process document development, in contrast to Taylorism, calls for the active involvement of workers in development and refinement of these documents (Adler, 1993a, 1993b, 1996, 1999; Edelson & Bennett, 1998; Monden, 1983; Suzaki, 1993). The objective of process documents today is to ensure that all workers are performing tasks in the same way, which is a necessary condition to achieve an adequate level of coordination between workers in order to obtain consistent output from the process. On the other hand, solid process documentation may help newcomers to adjust rapidly to the manner in which they are expected to work and perform. When all workers perform their tasks consistently, it becomes possible to run controlled experiments to test the impact of changing various process parameters. When a process change is shown to improve process performance, process documents are updated and workers are trained according to new documents (De Treville, Antonakis and Edelson, 2005).

Process documents gained great popularity among contemporary firms since they represent practical tools for understanding, analyzing, improving and standardizing processes (Ungan, 2006b). In order to develop high quality process documents, it is necessary for a firm to take several steps: (1) identify all processes within a firm, (2) optimize processes, (3) establish document hierarchy and define precise criteria for different document types, and (4) documenting processes.

Having all processes identified means becoming familiar with all the processes being run within a firm by making a list of them. The result is a process register (or catalogue) usually listing main process categories, which are being decomposed to groups, then processes and finally activities. Identified processes are usually classified using one of the mostly used and accepted process classifications, such as the one developed by Michael Porter (Porter, 1985) or by Jay Galbraith (Galbraith, 1998). The aim of developing a process register is to have an overview of all processes within a firm, identifying their scope and the manner in which they interconnect in order to create value for the customer, and knowing who is responsible for each process (identifying process owners).

After the process register is developed, the next step is to develop criteria for the sequence in which processes will be optimized. Process optimization starts with process mapping (developing process maps), then moves to stating the goals of optimization (achieving the same performance as competitors, minimizing costs, minimizing errors, etc.), continues with identifying process measures, performing benchmarking, analyzing AS-IS process, developing optimized (TO-BE) process, and finally ends with implementing optimized solution. Process optimization always results in process effectiveness and/or efficiency increase.

Optimized process needs to be standardized in order to be communicated effectively to all employees within a firm, but to do so, a firm has to have a document hierarchy in place. Establishing document hierarchy is a quintessential step in any firm, not only because of the need to document processes, but because it is necessary to prescribe the norms, values and rules that will govern a firm. Document hierarchy depends on firm's needs, but usually involves documents such as: policies, procedures, work instructions and records. Figure 1 illustrates usual document hierarchy in a firm.

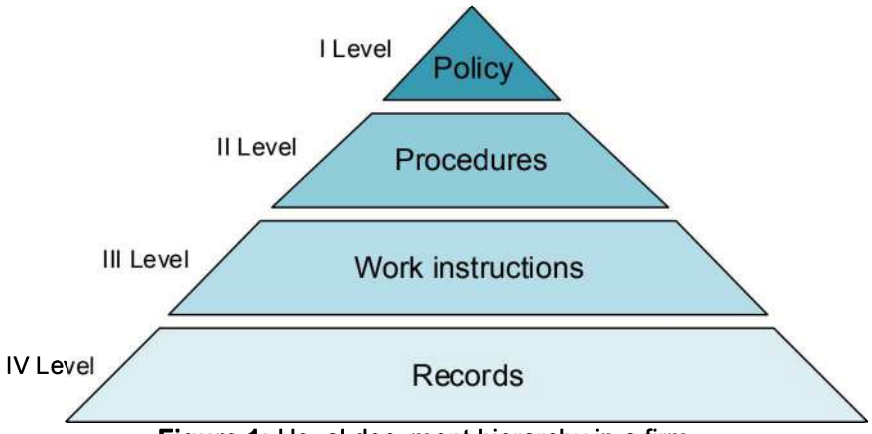


Figure 1: Usual document hierarchy in a firm

No matter what types of documents are defined within the hierarchy, each document type must have clearly defined criteria distinguishing it from the other document types. In other words, for each document type it must be defined what it is used for, what it describes, how it is connected to other document types, etc.

The final step in developing process documents is documenting the process according to the established rules (it is necessary to prescribe how the process is being documented). Very important aspect of documenting a process is to determine the level of detail in which the process will be described. Some authors indicate that process documents should not be very complicated and long, because such documents are difficult to comprehend and use (Babicz, 2000). On the contrary, Symons and Jacobs (1997) state that processes must be documented in sufficient level of detail to allow for substantial improvements. Another approach is taken by Ungan (2006b) who claims that level of detail in documentation depends on its purpose.

Next sections of this paper show how problem of documenting processes is being handled by three firms operating in Serbia. Their experience combined with theoretical background from this section will provide some insight for developing guidelines that will be helpful to other firms in Serbia struggling to gain competitive advantage through process standardization and process performance increase.

3. DOCUMENTING PROCESSES IN FIRMS OPERATING IN SERBIA

The following sections provide an illustration on the manner in which documenting processes is being done at three firms in Serbia operating in different industries: oil and gas, finance, and IT. Each of these firms is dealing with its own problems of process documenting, but the challenges they are facing bear some sort of resemblance.

3.1. Oil Company

The first firm described from the aspect of experience with documenting its processes is in oil and gas industry and will be referred to as the Oil Company. Oil Company is one of the biggest vertically integrated oil and gas firms in Southeast Europe. It was established in 1940s and since then it has gone through several periods of profound ownership and organizational restructurings, resulting in significant growth and business development. Nowadays its main activities are: (1) production of renewable energy, (2) exploration and production of oil and gas, (3) crude refining, and (4) sales and distribution of broad range of petroleum product. Oil Company operates in several countries in Southeast Europe and counts around 10,000 employees.

Due to the firm's size and complexity, one of its major challenges is to have all processes documented and standardized in a proper manner. Oil Company is coping with this difficult task by having established document hierarchy and precise criteria for different document types, continuously developing its process register, and trying to cover all the processes with sufficient amount of documents.

Oil Company has a very detailed business process register that is subjected to frequent updates. This document lists all processes being performed within the firm and its subsidiaries. It defines process hierarchy consisting of five levels:

1. Process category – the highest level in process hierarchy indicating basic business areas and grouping them into those creating value, the ones providing support and those that manage the business;
2. Process group – a set of interconnected processes within one business area;
3. Process – a set of interconnected and interacting activities that transform inputs into outputs;
4. Sub-process – a part of process composed of interrelated activities;
5. Activity – a unit of work composed of interconnected operations.

Business process register also indicates business owners on the first three levels of hierarchy: process category, process group and process.

Oil Company has developed its document hierarchy based on quality management system requirements. This hierarchy consists of three levels (depicted in Figure 2):

1. **Level I** includes the documents containing the main rules that apply to the whole firm, defined by management. These documents do not describe processes, but provide main guidelines and directions for action;
2. **Level II** refers to the documents describing process flow;
3. **Level III** comprises of documents describing parts of processes in a detailed way.

Since there are a lot of different document types in document hierarchy, each document type has a concise and clearly defined purpose, scope and criteria for its development.

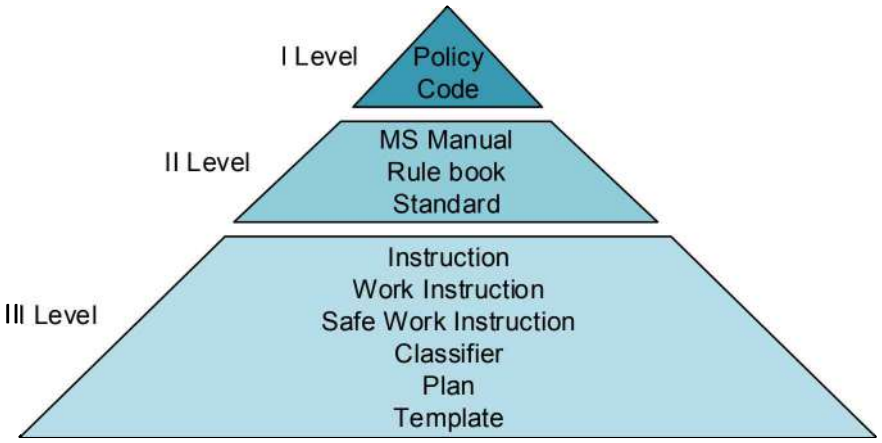


Figure 2: Document hierarchy levels in the Oil Company

When it comes to documenting processes, there are some formal rules that should govern the manner in which documents are developed, but this is not always the case in real life. For example, there is a rule that establishes relations between document hierarchy and business process register in a way that the first level of document hierarchy (policies and codes) concerns process categories, the second level (manuals, rulebooks and procedures) describes process groups and processes, while the third level (instructions, work instructions, classifiers, etc.) is connected to sub-processes and activities. Another rule proclaims that it is not allowed to have any repetition or collision within or between documents. There is also a rule concerning the number of procedures: one process must be described only with one procedure.

As already mentioned, these rules are not always being followed. As a result, some processes are not described in an adequate manner. For example, within Refinery process category, there is a process group entitled Petroleum Product Refining. One of the processes within this group is Raw Material Processing. This process is described by two procedures that have some overlapping – it is immediately clear that two aforementioned rules are broken in this case: the process is not described with one procedure and there is a repetition of text. Another example illustrates the case of insufficiently documented process: within Procurement process category, there is a process group entitled Procurement Planning that is defragmented into two processes – Procurement Plan Development and Inventory Management. Inventory Management is not documented properly – there is only one work instruction describing one activity in this process, while other activities are not described at all.

Even though Oil Company has made some significant steps on a journey toward documenting and standardizing processes, it still has a long way to go in order to develop a proper system with clear rules that will be obeyed by everyone in the firm.

3.2. Bank

The second firm experiencing significant challenges in the area of process documenting is operating in the finance industry and will be referred to as the Bank. Bank is one of the oldest banks in Serbia with a 145-year long tradition. It represents one of the most recognized local brands in the country. From 2006 the Bank is a member of one of the leading international banking groups. Today, it is among top ten largest banks in Serbia by asset size. With the fifth largest network in Serbia and almost a million clients, Bank covers the entire territory of the country.

During the last several years, Bank has developed a process register with process hierarchy consisting of three levels:

1. Process area – the highest level in process hierarchy indicating basic business areas, i.e., management processes, enabling processes, main processes and support processes;
2. Process category – a set of interconnected processes within one business area;
3. Process – a set of interconnected activities that transform inputs into outputs.

On the other hand, document hierarchy has never been established. There are a lot of different types of documents such as: policies, rulebooks, procedures, methodologies, instructions, work instructions, manuals, etc. Since the relations between these documents do not exist and rules for making them are not clear (except for procedures), it is very difficult to manage documents on a large scale. Due to this fact,

numerous problems arise when it comes to documenting a process, even though rules for documenting processes do exist. For example, Cash Management process is covered by 14 procedures and 1 rulebook with a lot of overlapping, but still one portion of this process has remained undocumented. After completing analysis of this process by the internal team consisting of process experts, it was decided to develop 2 procedures and two instructions that will cover the entire process in a satisfactory manner.

Based on everything said about the Bank, it is clear that it has just embarked at the beginning of a journey toward process documenting and that it will most certainly face numerous challenges along the way.

3.3. IT Service Provider

The third firm described in this paper operates in IT industry and will be referred to as the IT Service Provider. IT Service Provider is a recognized firm in global payment solutions established in 1998. It processes more than a billion dollars in transactions each year and is one of the largest third-party payment processors. IT Service Provider maintains a comprehensive set of proprietary backend and web-based administration systems to effectively process transactions for a wide variety of markets and help provide businesses the tools and practices necessary to successfully operate. In 2002, IT Service Provider decided to start supporting processing needs of European online merchants. It expanded its business to provide a processing solution to European-based businesses that wish to offer Visa as a payment option.

IT Service Provider has not yet finished its process register due to the fact that not all processes are identified. This is the result of focusing only on processes that have been selected as priorities for documenting. All the processes that have been identified were mapped with some of them even being automated using some cutting edge software solutions.

Regarding the process hierarchy levels, all identified processes belong to a particular category, which means there are two levels of hierarchy: categories, as basic business areas, and processes within these categories.

IT Service Provider does not have a document hierarchy established, even though it has several types of documents (procedures, work instructions, etc.), but with there are no relations between them. Criteria for different document types are not precisely defined and rules for documenting processes are not established. For example, a process is documented only if process owner realizes that process he/she is responsible for will be more efficient if documented. Process owner then chooses how he/she wants to document the process, create the document and share it with all process participants. If he/she wants to define all activities and responsibilities within the process, process maps are being developed. Alternatively, word documents and wiki pages are used to describe processes in more detailed way or to define main rules in some business area.

The problem IT Service Provider is facing at this moment is that there are still some unidentified processes, while some other processes are insufficiently covered by documents. For example, Human Resources is identified as process category. Within this category, process entitled Hiring, Transferring and Termination of Employees is documented and even automated. On the other hand, Payroll process, which is also located in this category, remains undocumented and even unidentified.

Therefore, the main challenge for the IT Service Provider is to complete identification of its processes and develop a business process register. After this is done, process mapping and documenting needs to take place for all the processes not being identified at this moment.

3.4. Comparative Analysis of Three Firms

Previous sections provide an insight into the challenges three firms operating in Serbia are facing when it comes to documenting their processes. After presenting each of these cases, it is interesting to make a comparison between them. Table 1 illustrates three firms compared on several parameters regarding documenting processes.

Analyzing all three firms at a glance in comparative fashion shows that Oil Company has gone the longest way toward process documenting, while the Bank is lagging and IT Service Provider is left behind due to the fact it does not satisfy any of the parameters provided. In reality, IT Service Provider, even though it still does not have its process register and document hierarchy developed, has gone the farthest way. All processes identified until now have gone through a very detailed mapping, optimization and automation using sophisticated software solutions.

Table 1: Comparative analysis of three firms operating in Serbia on documenting its processes

	Oil Company	Bank	IT Service Provider
Having all processes identified	X	X	
Document hierarchy established	X		
Precise criteria for different document types	X		
Rules for documenting processes established	X	X	
Rules for documenting processes obeyed		X	
Processes adequately documented			

After seeing problems all three firms are facing, it may be concluded that neither one of them is on a high level of documenting its processes, but every one of them is putting significant effort to reach that end.

3. RECOMMENDATIONS FOR PRACTITIONERS IN SERBIA

Documenting processes in a proper manner and enforcing employees to act according to the formal documents will most likely lead to standardized processes. Once this is achieved, processes are stabilized and predictable in terms of process performance. Due to the high frequency of repeating their tasks while working on some activities within a process, employees will be able to incrementally improve the manner in which they perform, resulting in increasing the overall process performance.

Several guidelines are helpful for practitioners in Serbia to reach this end. These guidelines should be understood as sequential steps that are required to be taken in order to start improving process performance on a continuous basis:

1. It is imperative for management to recognize the importance a proper process documentation plays in terms of understanding the process flow and its underlying logic, as well as why is that so important for competitive advantage of firm.
2. Management must start raising awareness among all employees throughout a firm about the need for proper process documentation and standardized processes.
3. Document hierarchy and process register should be developed and confirmed by all major stakeholders.
4. Process mapping needs to take place process by process according to the previously established priorities. This should be done with process participants who need to confirm that processes are correctly depicted with diagrams.
5. For each process mapped, process measures need to be developed and process measurement should take place.
6. AS-IS process analysis and TO-BE process development are the following steps, after which TO-BE solution needs to be implemented.
7. TO-BE process implementation should be accompanied with development of process documentation in order to effectively communicate the process flow to all stakeholders, especially to employees in charge for that process.
8. After the optimized process starts running and learning curve takes place, it is necessary to capture (document) any improvement that might come up along the way, as well as to systematically investigate and seize opportunities for further optimization.

Managing processes in this manner will most definitely yield significant results in terms of process effectiveness and/or efficiency increase. Even more, it will foster the development of a culture of continuous improvement that is more than needed to become an integral part of every firm trying to prosper in the competitive market.

4. CONCLUSION

Survival and thriving in contemporary business environment requires that firms manage their processes effectively. To do that, they need to become familiar with their end-to-end processes in sufficient level of details by documenting them in an appropriate manner.

Proper documentation requires that processes be presented in the simplest manner to make them easy to understand. Often, using a graphical flow chart can suffice to relay all the relevant information quickly and easily. The less complicated the process documentation, the easier it will be to ensure that all employees can deliver repeatable, quality outcomes for the processes.

Authors hope that this paper will contribute in filling the void that currently exists in the literature concerning the manner in which processes are being documented. On the other hand, we are also hoping that it will help raising the awareness of managers working in Serbia about the impact that proper process documentation may have on increasing process performance and making better business results. We claim that thorough understanding of the process flows within firm, as well as their underlying logic, may be of great significance for managers in times when they are making decisions that will impact the competitiveness of their firms in the evermore demanding marketplace.

REFERENCES

Adler, P. S. (1993a). The new 'learning bureaucracy': new United Motor Manufacturing, Inc, in: B. M. Staw & L. L. Cummings (Eds). *Research in Organizational Behavior*, Greenwich, CT: JAI Press.

Adler, P. S. (1993b). Time-and-motion regained. *Harvard Business Review*, 71, 97-108.

Adler, P. S. (1996) Two types of bureaucracy: enabling and coercive. *Administrative Science Quarterly*, 41, 61-89.

Adler, P. S. (1999). Building better bureaucracies. *Academy of Management Executive*, 13(4), 36-49.

Babicz, G. (2000). Give your process the right flow. *Quality*, 39(13), 34-36

de Treville, S., Antonakis, J., & Edelson, N. M. (2005). Can standard operating procedures be motivating? Reconciling Process Variability issues and behavioral outcomes. *Total Quality Management*, 16(2), 231-241.

de Vries, H. (1999). Standardization. Boston, MA: Kluwer Academic Publishers.

Galbraith, J. R. (1998). Linking customers and products: organizing for product and customer focus. In Mohrman, S. A., Galbraith, J. R., Lawler, E. E. & Associates. Tomorrow's organization. San Francisco, CA: Jossey Bass, 51-75.

Edelson, N. M., & Bennett, C. L. (1998). Process discipline: how to maximize profitability and quality through manufacturing consistency. New York: Quality Resources.

Jang, Y., & Lee, J. (1998). Factors influencing the success of management consulting projects. *International Journal of Project Management*, 16(2), 67-72.

Monden, Y. (1983). Toyota production system. Norcross, GA: Industrial Engineering and Management Press.

Porter, M. (1985). Competitive advantage. NY: Free Press.

Suzaki, K. (1993). The new shop floor management: empowering people for continuous improvement. New York: The Free Press.

Taylor, F. W. (1998). The principles of scientific management. Mineola, NY: Dover Publications (original work published 1911).

Teece, D.J. (1998). Capturing value from knowledge assets: the new economy, markets for know-how, and intangible assets. *California Management Review*, 40(3), 55-79.

Ungan, M. C. (2006a). Standardization through process documentation. Business Process Management Journal, 12(2), 135-148.

Ungan, M. C. (2006b). Towards a better understanding of process documentation. Business Process Management Journal, 18(4), 400-409.

symorg 2016
RESHAPING THE FUTURE THROUGH SUSTAINABLE BUSINESS DEVELOPMENT AND ENTREPRENEURSHIP

QUALITY MANAGEMENT AND INFORMATION: FROM STAKEHOLDERS REPORTING TO MEDIA PIONEERING QUALITY

Tamara Jakovljević*[1], Ana Čobrenović[2], Biljana Ranković[3]
[1]Faculty of Organizational Sciences, tamara.jakovljevic@hotmail.com
[2]Faculty of Organizational Sciences, anakafeplus@gmail.com
[3]Faculty of Organizational Sciences, biljarankovic@live.com
*Corresponding author, e-mail: tamara.jakovljevic@hotmail.com

Abstract: *This paper deals with the structure of the Media Center for Quality, also with the needs of all target groups and the public and analysis of them, in order to create specific offers of the center, along with the implementation of the quality management system in its work. It discuss the potential strategy to create a focal point for dissemination for information with regard of quality. The paper is also addressed to the directions of development of the Media Center for Quality that are specifically engaged with quality management approach, research and the provision of different services in the field of quality, but also deals with the existing trends and needs of the local market.*

Keywords*: quality management system, quality media center, stakeholders reporting*

1. INTRODUCTION

Firstly, it is necessary to say something about the field of interest of this work, and that is quality. If we look closer to the development of quality and quality movement in general, we can conclude that the fundamental needs for the emergence of quality on global market and society can be generated from the development of quality movement. The Movement for Quality traced its way back in medieval Europe, where the craftsmen were organized in unions, so called guilds, in the late 13th century. Quality management in the guilds took up a very important place. It created check-ups, controls and certain forms of audit, performed by craftsmen, to ensure compliance with quality specifications (Filipovic J., Djuric M., 2008)..

The quality system is defined as "a set of interrelated or interacting elements which is using a variety of resources to achieve objectives related to quality." These objectives are focused on fulfilling and overcoming user's requirements (Filipovic J., Djuric M., 2010).

Examples of international practice show that the issue of quality and business excellence can not be reduced only to the implementation of standards, but also to a comprehensive organizational reports of the business and working methods (Weissingeer R., 2014). In order to fully meet the requirements of all stakeholders and interested parties, organizations must provide a valid, up to date information of the business methods. It can no longer be only the financial statements, but information that provide insight on procurement, manufacturing, suppliers, vendors, working conditions, social responsibility and other activities of interest to stakeholders. (Idowu S. O., Louche C*., 2011)*

Worldwide, and especially in Serbia and the region, there is no existing consensus of opinion when it comes to corporate reporting and quality. The practice is tantamount to parts of PR campaigns and the work of advertising agencies.

Strategic communications will become a key factor for all organizations - whether it is a public, private sector and civil society. Communication can play an important role in removing misconceptions, resolve conflicts and bring together the common sides to improve the world in which we live. (Aras G., Crowther D, 2009)

2. GLOBAL TRENDS IN QUALITY REPORTING

The global market has been allocated to several organizations that deal with quality, quality research and quality reporting. Some of them are:

- International Organization for Standardization (ISO),

- Global Reporting Initiative (GRI),
- UN Global Compact (GC),
- Organization for Economic Cooperation and Development (OECD),
- Global voice of quality (ASQ) (the American Society for quality),
- International integrated reporting Council (IIRC) and others.

ASQ business model could be one of the key models for establishing a strategy for the development of the Media Center for Quality in Serbia. ASQ is organized primarily as a global network, which provides information on the quality, certification, training, seminars, conferences, meetings, literature, and above all it provides training, performs certification of quality managers, organizes scientific meetings and conferences for its members and provides a unique database which is formed during many years of research, and a database of professional literature and other information in the sphere of quality. (Campanella J, 1999)

2.1. IIRC solutions

International Integrated Reporting Council has developed a model of integrated reporting "IR" as a process that is based on integrated thinking which results as an integrated periodic report on the organization's created value in terms of the communication aspect of creating value. (Integrated reporting, 2011)

The integrated report reperesents a summary of ways of leading the communication strategy, management, organization's performance and its objectives in the context of its external environment, to the creation of value in the short, medium and long term.

Business and investors need IR, enterprises need a reporting environment suitable for understanding and articulation of its strategy which helps with keeping the performance internally and attracting financial capital for investment. Investors need to understand how the strategy creates value over time.
Integrated reporting is the market's response to nowadays challenges in corporate reporting. Businesses and investors from more than 25 countries are the pioneers in the work of the IIRC (International Integrated Reporting Council) and they have contributed to the development of an international integrated reporting framework.

IIRC has attracted the world's leaders and has included integrated reporting in their business network. Those are the companies such as Unilever, HSBC, Deutsche Bank, Hyundai, Microsoft, PepsiCo, National Australia Bank, Tata Steel and over a hundred more.

2.2. Global Reporting Initiative and IR

Along with the development and implementation of standards, there was the practice of reporting companies on the way of doing business, as a norm of quality. GRI (Global Reporting Initiative) introduced the practice of making recommendations and guidelines for the preparation of such statements, which are necessary to achieve business excellence, and which later are stabilized as a practice on the International level.

Companies should include in their reporting practices in the real world and real time. Very few companies have voluntarily signed up for a transparent way of doing business, although some have taken the initial steps. Transparency in corporate reporting is easy to describe, and implement it in practice is the hard part. All actors want information of high quality, delivered on time, in a form they can use them. They also want information that will give them a complete picture of the performance and to be updated as often as necessary. (Samuel A., Robert G, 2002)

Successful companies will have an integrated strategy for achieving financial results in the future, in order to create lasting value for themselves and for all stakeholders of society. The integrated report should be the result of an integrated strategy and integrated reporting process.

3. MEDIA CENTER FOR QUALITY AND GENERATING TRENDS

Media Center for Quality should represent an upgrade of its kind of organization. It will not only create a network of corporations, institutions, other stakeholders and interested parties concerning quality, databases and working method reports, but it should be able to arrange consultations and trainings by the listed world centers and create sustainable connections with them. It should also be the initiator of conferences, dialogues, seminars and other business events and provide adequate information, conclusions and reports

from such events, making them available to the wider community, and in order to business and social progress. The Center should basically gather the information about quality, standardization, implementation of standards, certification, control, and then to connect the public, institutions for standardization and consulting agencies primarily with companies and their stakeholders and all other potential users of such information and services. The information that it receives from its members and program participants should be selected and appropriately presented to the public and to other media centers. Within the Media Center for Quality, users will be able to obtain information on global trends in the field of quality, training, seminars, summits, literature, and the local market.

This center should give an important role to scientific research, as a part of its main activities. For the research process and professional consulting, as well as for organization of lectures, panel discussions, dialogues and conferences, Media Center for Quality may primarily hire professors and associates of the Faculty of Organizational Sciences, also students who can gain a practical experience by participating in the work of the Center.

The profitability of the center can be achieved by membership and by package of services that the center may provide in accordance with the status of the members.

Furthermore, one of the innovative solutions is also the establishment of the Center's video channel with uploaded lectures which may be included in the service package. The lectures would be run by experts, and would be about certain topics, conclusions of conferences, and specific meetings.

Media Center may represent their clients and large corporations which have no conditions or staff for performing tasks of corporate reporting and communication with stakeholders, society or state.

In Serbia and the region, there is no organization type similar to Media Center for Quality, so its establishment under the auspices of the Faculty of Organizational Sciences, can very quickly gain key role in the field of quality in our region, thanks to human resources, knoledge, contacts and reputation as a competitive advantage in relation to other institutions and centers.

In regard to global business trends, as well as regulations of the European Union which require the implementation of quality standards in the business, the need for real, proven information on the quality, finding new solutions through research and reporting in this area will eventually get significantly better. For any successful business it is important to be a step ahead, and the Media Center for Quality has such a starting point.

3.1. Case Study – NIS, as a guideline for Media Center for Quality

When we talk about the market of the Republic of Serbia, considering quality and business excellence, the work of one of the largest and most successful companies - Oil Industry of Serbia (Naftna Industrija Srbije), can be considered as a case study.

The company follows global trends in the sphere of quality and it can be considered to be the leader in the region when the application of standards and reporting are concerned. NIS applied global trends primarily through transparency of its operations and business.

We can see that they prepared their annual reports on the work of the company, as well as reports on sustainable development in according to the guidelines of the GRI (Global Reporting Initiative), and also that the implementation of quality standards can be observed through the organization of their business and the availability of other types of documents, such as company profile.

NIS applied the Indicators of GRI agencies for the creation of the report, and audit was conducted by KPMG. Model of the NIS company can also be applied as an indicator of market needs, but also as a guideline for the offer of Media Center for Quality.

Profile	DESCRIPTION
3.3	Reporting cycle
3.4	Contact for questions about the report and its content
3.5	Methodology of preparing the report and a procedure for determining the content
3.6	Boundary of the report
3.7	Limitations in scope and boundaries of the report
3.8	Basis for reporting on joint ventures
3.9	Techniques of data measuring and basic calculations for the estimation
3.10	Explain existing corrections of data from the previous report
3.11	Significant changes comparing to previous reporting periods
3.12	GRI indicators
3.13	Audit (revision) report

Figure 1: GRI reporting indicators of the NIS company

Therefore, this is the company that has introduced quality standards, follows the trends of global organizations when reporting and its control is concerned, continuously strives to improve performance through review and training, takes care of the community and works in a transparent manner.

It can be considered as some kind of a model for quality, so when it comes to services that Media Center for Quality provides, directions for quality to be drawn in dealing with this type of companies are:

- Monitoring and present global trends in the field of quality to customers in Serbia and the region, as well as creating a link between these organizations and companies in Serbia;
- Analysis of user requirements, coordination and consultation with a certified and professional staff of the Media Center for Quality;
- Training and advising about the implementation of standards, certification and reporting;
- Control, review and improvement;
- Connecting community groups, organizations, institutions (companies, governments, NGOs, experts, consulting companies, institutes, media centres);
- Distribution of information from the client to its stakeholders;
- Presentation of trends, research results and reports of companies, as well as their connecting to other target audiences and media centers;
- Organizing dialogues, conferences and seminars and presenting new solutions;
- Publication, reporting and transfer of trends in the field of quality at the local level.

3.2. The mission of the Media Center for Quality

The mission of the Media Center for Quality is creation of social solutions when it comes to the field of quality, through development of an organization that continually reviews its options, following global trends of quality and passing them on the local market. As already mentioned more complex systems, this organization should belong to a kind of network that will provide quality services information to certain users by linking and grouping them by their interests, providing the necessary information in the sphere of quality in an appropriate manner and by creating databases and the ability to further research.

3.3. Objective

The objective of the Media Center for Quality is a successful notification of targeted public about the quality, organization of scientific meetings and an increase of the number of reports, implemented standards and certified workers in the field of quality.

3.4. Creating a strategy of the Media Center for Quality

The key of the strategy of development of the Media Center is to identify market needs, as well as the continuous improvement of the organization itself in accordance with those needs. As in the theory of

complexity, in this case the most important thing is to set up a clearly defined line or points of support depending on which the structure itself and the offer of organization will continue to change along with market trends and social conditions. (Johnson, G.; Scholes, K., 1988)
Finally, that points of support are knowledge, networks, learning, feedback of national and transactional and cooperation.

3.5. Strategic Analysis

In order to better formulation of development strategy for Media Center for Quality, we should explain all the factors that affect it.

A careful plan or method designed to achieve the goals of the organization, is often called strategy. It means doing the right things at the right time in order to ensure success in the future. From the perspective of the leaders in the company this means focusing on the future survival and success of the company. Traditional concepts assume that adequate strategies will be generated according to the systematic analysis and assessment of the current situation. These methods can then be implemented in order to take the company on the road of successful future. Johnson and Scholes present a basic model for the development of strategy. Getting an overview of the options and choosing the right strategy is based on the strategic analysis.

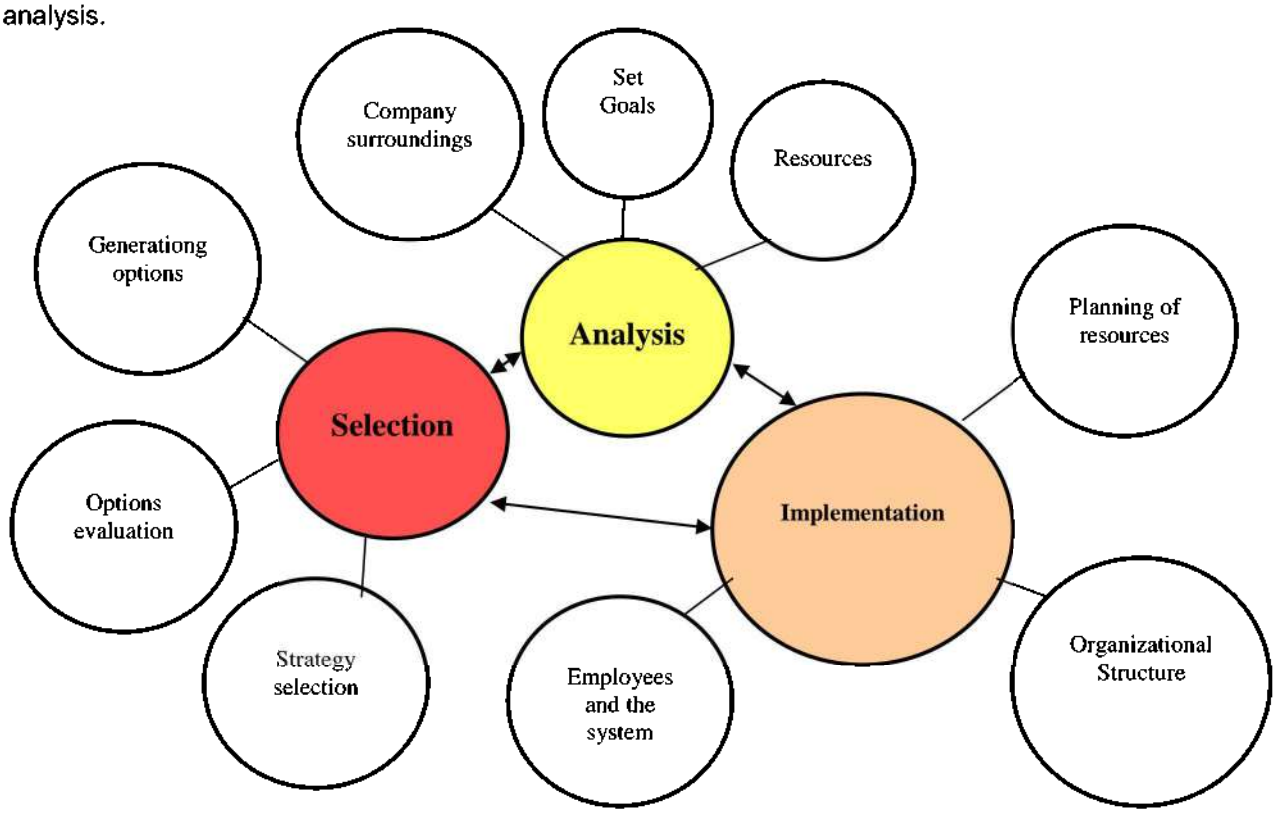


Figure 2: A copy of the Corporate Strategy: It is not this easy: Corporate Strategy (Johnson 1988.)

To formulate a strategy for the development of the Media Center for Quality, it is necessary to go through the process of analyzing the factors that affects its analysis, selection and implementation. Recognizing the indicators for analysis, selection and implementation is different on each case:

- Analysis - Indicators are recognized through the company surroundings analysis, set goals and resources;
- Selection - Indicators can be recognized by generating options and selection of strategic decisions;
- Implementation - Indicators are recognized through employees and the system, organizational structure and planning of resources.

4. CONCLUSION

On the one hand, regarding to its organizational structure, Media Center for Quality should make a network of social subjects, inform them in the right time, and also should provide them the access to the services related to quality. On the other hand, it should make available the information related to quality and enable

their further distribution and channeling to the requirements of other users by following the movement of information society and work of other media centers, and by the use of certain media.

Based on the analysis of the global trends of Quality, local case study, all the analysis needed for formulating Media Center for Quality's strategy of development according to prior check and knowledge of rational planning trough the corporate, global, business and functional strategy, it has come to the conclusion that the strategy can be created trough several key points, such as: knowledge, network, learning, national and transactional feedback, and cooperation.

According to trends that indicate complexity, synergy and cooperation, points of support are the foundation of the structure and operation of the Media Center for Quality, leaving the opportunity for development which follows new market and social trends.

Besides transferring knowledge, information and networking, the Media Center needs to needs to enable a proper analysis of requirements for each client and their further coordination to other clients and stakeholders.

Competitiveness is achieved by competence of human resources, the reputation of the founder institution, the existing infrastructural, technological and communication resources, but also by possession of databases, knowledge, contacts and experience in the field of quality, certification and standardization.
Profitability can be acquired by making an appropriate package of services and products for customers and members, also by the status of members of the Media Center for Quality publishing, and by distribution of information and knowledge through certain media. (Tapiero S. C., 1996).

Some companies apply social and environmental reporting for 15 years, but for many others it is still new. Most companies - mostly large enterprises - presents these information in the form of a report. Over time, these reports have become more extensive and more detailed with a wider range of measures of social and environmental performance included. Therefore, most organizations have reached this stage of maturity. The problem today is that there are no standards that indicate what should be reported, so the organizations still report on various matters, thereby impeding comparability. Therefore, it is probably true that this is a crucial phase of development for most organizations. (Aras G., Crowther D, 2009)

Without coordination with other companies and stakeholders, the impact of their operations may be limited. Partnerships with governments, international organizations, non-governmental organizations and other enterprises can greatly help to maximize the potentials of the company.

Formation of the Media Center precisely represents the necessary type of social solution that has to connect users, manage their requirements, analyze their needs and continue the distribution of knowledge and information gathered during the work.

REFERENCES

Aras G., Crowther D. *Global Perspectives on Corporate Governance and CSR*, Gower Publishing Limited, Library of Congress Control Number: 2009936804, 2009.

Campanella J., *Principles of Quality Costs*, American Society for Quality, 1999.

Filipović J., Đurić M., (2009).*Fundamentals of Quality*, Faculty of Organizational sciences, Belgrade,

Filipović J., Đurić M., (2010).*Quality management system*, Faculty of Organizational sciences, Belgrade,

Global Reporting Initiative, (2013) G4 Sustainability reporting guidelines, GRI, Amsterdam

Integrated reporting, (2011), Towards integrated reporting, IR, December

Idowu S. O., Louche C.*(2011.), Theory and Practice of Corporate Social Responsibility*, London Metropolitan University, ISBN 978-3-642-16460-6

ISO, *Quality management principles*, ISO Central Secretariat, ISBN 978-92-67-10573-4, 2012.,

Johnson, G.; Scholes, K., (1988). *: Exploring Corporate Strategy.* Englewood Cliffs, NJ: Prentice-Hall on Business and Economics Research vol.1 ©(2011) IACSIT Press, Kuala Lumpur, Malaysia

Lerbinger, O., Corporate public affairs: *interacting with interest groups, media, and government* / Otto Lerbinger. p. cm. — (LEA's communication series) ISBN 0-8058-5642-0 (cloth: alk. paper)

NIS, *Statement on the sustainable development,*

Samuel A., Piazza J., (2002). Robert G., *BUILDING PUBLIC TRUST - The Future of Corporate Reporting,* Advisory Capital Partners John Wiley & Sons, Inc., New York,

SustainAbility, UnitedNations Environment Programme, Ketchum, Good news and bad- The Media, Corporate Social Responsibility and Sustainable Development, SustainAbility Publications, ISBN 1-903168–04-X, 2002.

Tapiero S. C., (1996). *The Management of Quality and its Control*, Chapman & Hall, ISBN 978-1-4613-5852-7.
Weissingeer R., *ISO 9000 Quality management systems*, University of Geneva, Master in Standardization, (Date: 2014-03-17)

HOLISTIC APPROACH TO CONSULTING FOR QUALITY SYSTEM AND OTHER MANAGEMENT SYSTEMS

Ana Trajković*[1], Branimirka Mihić[2]
[1]University of Belgrade, Faculty of Organizational Sciences
[2]Advensa-BM, Pancevo, Serbia
*Corresponding author, e-mail: ana.trajkovic@fon.bg.ac.rs

Abstract: *Since the popularization of application of international standards, consulting plays an important role in the implementation of quality systems and other management systems. The beauty of consulting is that in its framework, it allows creativity and offers opportunities for innovation. This paper suggests three dimensions of consulting that can help in achieving success in the implementation of management systems, while presented model suggests a holistic approach. For the purpose of thorough explanation of certain claims, the examples from practice are offered that show that masterpiece actually consists of fine details. If by reading this article, consultants or those who are about to become consultants, acquire an idea how to help an organization in the implementation of the management system, then the goal of this work is fully achieved.*

Keywords*: consulting, quality, standard, management systems, holistic approach*

1. INTRODUCTION

For many years, consulting work in the field of management systems, stands as the main link between standards in the international arena and business systems that operate in free markets. Although the responsibility for the implementation of management systems lies with the organizations, it is consulting that has significant influence on whether the system will be adequate for the particular organization.

Figure 1: Consulting as a link between international standards and business entities

As almost all areas are regulated by an international standard, so the consulting has received its frameworks in the standard EN 16114: 2011 - Consulting Services in management. The International Organization for Standardization (ISO) is currently developing a standard ISO 20700 - Guidelines for the provision of consulting services in management.

However, as it is stated by Mr. Jeremy Webster from the Committee on Professional Standards (BSI) standard EN 16114: 2011 deliberately foresees only inputs and outputs in the process of consulting leaving it to consultants to apply different methods of work with clients. This has encouraged innovation and diversity that consultants must apply in their work. As the framework of providing services in consulting has already been clearly defined, skills to provide consulting services are reflected in the commitment to each organization separately.

Insight into the statistical data on the number of certified organizations and standards that have been implemented in those organizations unfortunately does not tell anything of the quality of these systems and the improvements that they bring, primarily to their business system and then to the development on the local, regional or global level. Although the standards are the framework within which we must operate in order to meet the requirements, there is always the opportunity for experts

who work on the implementation of these systems to make their unique "stamp". Within professional circles it is well known that a management system must rely on System and Process approach. However, in order for the consultant to be on his way to be proud of his work, he should apply Holistic approach.

Seldom is an organization really identical to another one, so it goes without saying that the consulting should be tailored to the differences. Any management system must be implemented so that it is perfectly suited to the organization and not to be "a tight shoe." Often, in practice, we see systems that focus on documentation and form and the proof during a certification audit can only be seen on paper by repeating platitudes composed of technical terms of each individual management system. What is the added value of such management systems on an everyday level, it is hard to assume and measure.

2. 3D MODEL – HOLISTIC APROACH TO CONSULTING

Consulting is a profession universally accepted and well entrenched throughout the business world. Whether it is providing objective analysis, supplying a specific expertise, managing a project, or simply adding extra manpower, consultants can add value (Pliner N., Thrall J., Boland G. and Palumbo D., 2004). In order to achieve the best results and meet the goal of implementation in each segment, it is necessary to approach completely, i.e. holistically. Knowing that any form is geometrically best represented in the three-dimensional coordinate system, and that this is the only way to examine its real dimensions, we will apply the same analogy to consulting services aimed at the creation of a particular organization in accordance with the requirements of the quality management system, environmental management, occupational health and safety, information security and others Figure 2.

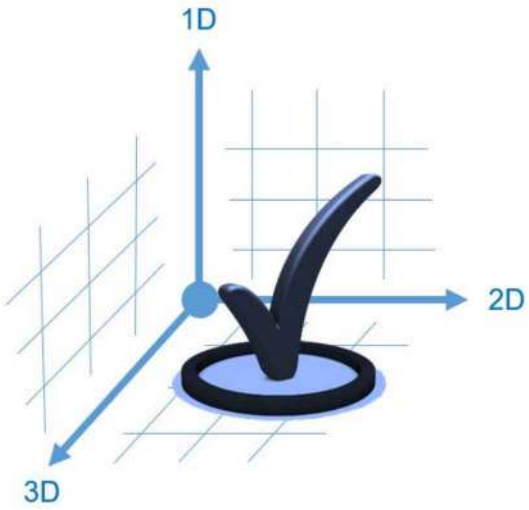


Figure 2: Dimensions of holistic approach to consulting

2.1. The first dimension – organization (1D)

- Size of the organization
- Method of organizing
- Type of business activity
- Financial and infrastructural capacities.

The volume of documentation to be expected depends largely on the **size of the organization**. However, conclusions should not be made ad hoc. Usually when we hear that the organization has a large number of workers or more locations, it can be assumed that it is a complex and demanding organization. Although in most cases, a more extensive work on the implementation of the system may be expected, sometimes this is not the case. Attention should be paid to the number of

employees in certain workplaces, processes should be identified and the mode of communication should be determined.

For example: production organization which has 400 workers and complicated process model cannot have the same volume of documentation as a distribution organization that also has 400 workers. Distributor organization has mostly employed the drivers who do the delivery and this is the most important process for them. On the other hand, in the manufacturing organization, arranging of production requires much more attention and precision, and the connection with other processes is multiple

The previous example touches **the type of the activity**, which also greatly affects how the requirements of the standard will be met. In this case there is also a link with the third dimension of the model, which, among other things, provides legislation that sometimes significantly differs for various activities. Those who provide consulting services should take into account that the process of standards implementation will run faster and easier if the consultant who personally lacks technical knowledge of the industry, hire a person who will act in the capacity of expert advisor.

The method of organizing, regardless of the management system, affects the allocation of responsibilities, powers, speed and effectiveness of internal communication. There are many forms of organizing but everybody has an obligation to describe them in detail through the organizational charts and job systematization. Consulting must begin by learning the methods of organizing.

For example: Statistically the most common is a functional method of organizing, however there are organizations that have chosen project method of organizing. If one looks at just this aspect of an organization, it is clear that the management system itself will vary. While the first organization must clearly identify all the functions because their job descriptions are separated, the second organization focuses on projects.

Very often, the measures that can realistically be implemented by the organization depend on **financial capacities**. This is especially true for the infrastructure for which it is usually necessary to engage significant financial resources. Some activities, such as food production, for example, have specific requirements when it comes to infrastructure. A consultant does not need to know exactly how much funding the organization has but it is necessary to gain insight into their capabilities and show understanding when proposing solutions that involve spending money. In this way, besides providing the best solution for the organization, consultants will also show their commitment to the organization and gain its trust.

2.2 The second dimension – human resources (2D)

It is not enough to understand a business, one should understand people as well. Although this often ends up with defining the organizational structure, division of responsibilities and determining the number of staff, consultants should pay more attention to employees. After all, they are the ones who will implement and improve the management system. In this regard, it is necessary to pay attention to:

- The educational structure
- The age structure and personal constraints
- The way of thinking
- The cultural framework.

Each consultant must be prepared to recognize the way of thinking of people working with him on implementation in order to get the right answers to the questions. It should be noted that the extent to which the consultant will motivate top management to participate fully in the implementation process also depends on this. In the case that the consultant speaks a language they do not understand, management will quickly pass their participation in the implementation process onto other employees.

If the organization has a large number of engineers or lawyers, the approach must be adapted to their way of thinking. Different professions have different views on the same issues. Sometimes the success of the implementation of the management system depends on that, so it is important to have insight into the **educational structure** of employees.

Besides educational structure, age structure is also important since sometimes solutions that are to be used depend on it too. This implies that the habits of experienced people are probably already formed and it is better to use solutions that they are used to as this will ensure efficiency and effectiveness in the implementation of quality systems. This applies particularly to information technologies the changes of which are more easily followed by younger generations who are susceptible to significant changes.

Also, the argument is that manufacturing SMEs have not considered socio-emotional and intellectual factors and ethics values within a quality culture, that is part of an integrative model of QMS to improve the aptitude and attitude of people who represent the most important value faced to any other asset in the business, and can carry an innovation process and value-added products and service to get customer and stakeholder satisfaction (Hernández, González and Aquiahuatl, 2011).

All of us in some way participate in the struggle neither to let **personal constraints** to reflect on the job nor the employee to be treated differently because of that, but in certain situations it is important to choose a solution that will fit into personal limitations. It is therefore very important to have that type of information as well. How ignorance of this aspect in employees can directly influence the implementation and sustainability of the system, can be seen from the following example:

For example: The obligation of any organization that is engaged in the production of food is to provide separate kits for the maintenance of hygiene in industrial and sanitary facilities. One of the common ways to solve this is to purchase kits of different colors. The organization has implemented this method, done risk analysis, defined work procedures, formed the records, provided kits, however it was found after two months that one of the hygienist is color-blind and very often mixes kits. The hygienist in question considered that this is the rule and did not question the decision of management and no one asked if such separation of cleaning kits suited her. Such a mistake at first glance may seem trivial, but it can unfortunately lead to disastrous consequences in case of contamination of food by bacteria of fecal origin.

The business world usually takes into account the organizational culture and works on its construction, however, when it is necessary to introduce certain changes, the general cultural context must also be taken into account. The beauty of the management systems is that they are designed to fit into any country, however consulting must have more knowledge of the cultural environment into which the management system has to be implemented. This applies to both communication with people and the solutions that are an integral part of the management system. It must be borne in mind that sometimes people are very sensitive to disrespect to their cultural values and that can be one of the main obstacles in the implementation process.

2.3. The third dimension - socio-legal framework (3D)

Through the first two dimensions the internal environment and the characteristics were considered, however the third dimension that is focused on the external environment is required for a more complete insight. Some elements of the environment are:

- Legislation
- Interested parties (social framework)
- Customary law.

It is well known that legislation is the basis for all management systems. Virtually all solutions of management system must be in accordance with the legislation. In addition to standards obliging organizations to undertake regular monitoring and implementation of legislation, it is important that consultants have precise knowledge of legislation. They are required to have the skill of interpretation of the law, on which sometimes depends whether the organization can adequately coordinate the requirements of the standards and requirements of the law.
In order for an organization to conduct business seriously, it must identify its **interested parties** and regulate its proceedings in accordance with them. Consulting should also seriously consider the interested parties because a number of activities that are part of the management system may depend on them.

For example: According to the claim of standards, a consultant has predicted that suppliers should be identified and evaluated, but has not conducted a detailed study of the structure of suppliers. Without

this information, procurement procedures were established, which projected that foreign suppliers should be contacted every Friday, with the obligation to confirm the deliveries for the beginning of next week. The idea of this solution was to organize "Just in time" supply and to reduce storage costs. However, as soon as the first week of the application of the procedure, it was found that 30% of suppliers come from the Arab region and it was not possible to apply the approach because Friday is their day off.

The importance of customary law may sound redundant when considering the approach to consulting. However, in all communities, there are traditions deeply rooted in the behavior and although not part of the legal and legislative norms, they often carry the same weight. They should be taken into account both in the part that relates to the communication between the consultant and representative of the organization and in the creation of solutions as part of the management system.

3. POTENTIAL PROBLEMS IN CONSULTING

In every profession, although it sometimes indicates problems, experience actually represents a source of valuable information which identifies room for improvement and raise the knowledge and skills to a higher level. Therefore, it is necessary to recognize the potential problems that may arise in the consulting business because it is the only way to prevent their actual occurrence.
Some of the problems could be:

- **Routine** - mapping systems from an organization of the same type of business activities. - In practice organizations that have the same business activity, sometimes have only that in common, the same activity. The process model may be different, the method of organizing also, as well as many other elements that are of great importance for the design and implementation of a management system.
- **Establishment of documentation without taking into account the level of knowledge of those who will actually use those documents**. – Grudzień Ł., Hamrol A. (2016) discuss the main function of information found in process documents is to provide knowledge regarding how to executing a process and to standardize this process by providing a specific path of execution. However, it is not easy to determine a standard level of quality of process information optimal from the viewpoint of the owner and the process executor. After the consultant leaves, documentation that remains has to be an essential tool in the everyday work of the organization. If what it says is clear only to the consultant, it is not a system that will bring the improvement to the organization.

  For example, if people with disabilities are hired for simple operational tasks, what should the instructions be like? Will the paper full of words be more useful than pictogram with simple sentences? Probably not.
- **Meeting the form and not the substance** - every document of the quality management system or any other management system must have a defined shape, however it must seriously deal with the substance. If the document does not give precise answers who needs to do what, when and where, it usually deals more with the form rather than substance. This potential problem particularly applies to procedures.
- **Developing a system for external auditors** – To cut corners – All experienced consultants and their systems were subject to certification audit and as professionals they record remarks of external auditors. Since the auditors have the freedom to interpret the extent to which a requirement is met, consultants may unconsciously think not about how to really help the organization but to go through the audit without any complaints. To a consultant the client should always come first. His task when it comes to the external check is to defend a system that he designed specifically for that client.
- **Too little time to get to know the organization and establish the initial balance** - Market needs - Although in practice sometimes to customers a motive for entering into the process of implementation of an international standard is not primarily the improvement of its operations, but only the requirements of the market, the consultant still must provide sufficient time to get to know the organization itself.
- **Lack of creativity** - Whether consultants will literally apply all the requirements of the standard, or they will have an innovative look at them always depends on their interpretations of standards, personal styles and experiences. Regrettably, completely uninteresting documents and solutions that add no value to management system may be encountered in practice. One should bear in mind that clients must recognize themselves in the

documentation. It is not good if it takes only one look on the documents to recognize the consultant who worked on the implementation of the system.

- **Inadequate volume of documentation** - generally accepted claim that **"what is not written, has never even occurred"** may be supplemented by the following statement, **"but also if something was written down does not necessarily mean it happened."** Sometimes the wish of the consultant to create the best documented system may lead into oversize records which are burden for workers who have multiple tasks. Often in practice we find that the records are filled mechanically at the end of the day, sometimes without checking the actual situation. It is desirable that the consultant steps out of the generally accepted "fill in the chart" system. It is always good to ask whether this volume of documentation will provide the realistic data.

Also, according to Mingaleva Z. (2013) “consulting is carried out in the field of activity in which the ethical code is simply necessary. The basic ethical standard for the adviser means not to abuse the trust of the client. Only trusting the adviser the director can tell him about the problems in business and will allow him to use confidential information of the enterprise and will follow the recommendations”.

4. IMPACT OF CONSULTING ON BUSINESS SYSTEM

Greiner and Metzger (1983) define management consulting services as “an advisory service contracted for and provided to organizations by specially trained and qualified persons who assist, in an objective and independent manner, the client organization to identify management problems, analyze such problems, and help, when requested, in the implementation of solutions” (p. 7).

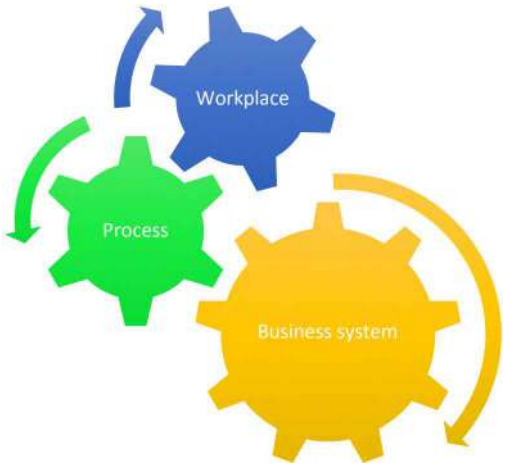


Figure 3: The mechanism of influence in one business system

When the process of implementation of a management system is entered, one of the main goals is to bring an immediate improvement to the organization and provide tools that these improvements are continuous in the future. On the effects of the application of quality systems or other management systems, there are a numerous studies and works and they all clearly testify to the positive effects on the business system.

However, in order to know how consulting influences what the effects will be like, it is important to understand the mechanism of influence within the business system (Figure 3). Unless even the slightest positive change is brought to each position, we cannot expect that the entire operating system will benefit from the management system.

4.1 The mechanism of influence in one business system:

- Workplace
- Process
- Business system

The direction of the individual workplace determines the direction of the entire business system. Mutual influence is inevitable and the only proper one in a well-implemented system.

The consultants are asked to give advice, to discover and propose solutions and to participate in their implementation in a wide range of issues related to company management. If we are to look just at the pole of the field of action of the consultants we may say that they can offer either classical solution, tested methods, properly defined instruments, in a standardized format, or new methods, solutions and instruments tailored to the specific situation of a client (Ciumara T. 2011).

Sometimes the opinion of operatives is unconsciously disregarded in the implementation of the management system. Thus is the initial and expected resistance only increases and the expected change will not be possible. It is extremely important that all employees, regardless of hierarchical levels understand that it is in the interests of them all and why it is important for the entire business system. If they their personal role in the improvement of the organization is clearly presented to them, the greater the chance that they will not only scrupulously respect the rules of the system, but also possibly make suggestions for improvements. For example, small number of employees, which means cumulative responsibilities and functions, especially in manufacturing companies, reducing the number of procedures, along with a document management using information technology, can be a solution to simplify QMS in order to increase its effectiveness (Pop L. D.,2016).

All data which are discussed in the annual management review speak of the importance of a single employee. Consulting service suppliers have the obligation to explain how the operation of one employee affects the operation of the other, how it reflects both on the process and the entire business system. Until a consultant does not ask himself who he designs the system for, the implementation and application of the management system can give unexpectedly bad results.

5. CONCLUSION

The term "holistic" is mentioned in the literature together with the description of the quality system however it is necessary that the approach in its implementation also be holistic. Thus the circle that leads us to permanent improvements is closed. From all aforesaid, it can be concluded that the consulting is more than just a job. Management consultants are often central figures in not only the promotion and diffusion of new organizational practices, but also their implementation (Wright, Sturdy and Wylie, 2012). As it were, it has a unique mission that can bring a lot of benefits not only in the level of the business world but in generally. The model presented is a good tool that helps in understanding all the basic elements that can affect both the effectiveness and the uniqueness of the implemented management system. The model also implies that the consultants should have a wider knowledge and a lot of experience in real business systems. By raising awareness of the seriousness of the consulting work, we encourage the next generation to improve methodology and maintain credibility that this profession requires.

According to Srinivasan R. (2014) the challenges facing the management consulting industry fall into three broad categories:

- Competition and differentiation
- Organizational design of the management consulting firm
- Internal organization of knowledge flows to serve client needs

Ciumara T. (2011), discuss most of the consulting services are situated somewhere between absolute standardization and absolute innovation. It is important to find a balance between innovation and standardization to maximize the results of all agents involved. As Larina L. N. (2015) discuss the system of components management should correspond to a flexible structure, adaptable to users' needs and a changing environment, which organizes and maintains the processes' functioning and creates a medium for their existence. The quality management system is an integrated instrument of management for all processes. It is necessary, however, to form not only the quality system as a priority, but also the integrated management system as a whole, and there it is important that consultants play a key role.

REFERENCES

Ciumara T. (2011), Standardization versus innovation in management consultancy, Microeconomics, Financial Studies 4, 145-154.

EN 16114:2011 (E) – Management consultancy service.

Grudzień Ł., Hamrol A. (2016), Information quality in design process documentation of quality management systems, International Journal of Information Management, Volume 36, Issue 4, August, 599-606.

Hernández V. M., González B. P. & Aquiahuatl E. C. (2013), Human approach in the quality management system of manufacturing SMEs in Mexico. Theoretical review and proposal of a conceptual model, Contaduría y Administración 58 (2): 113-133.

Larina L. N. (2015), Practical Application of Total Quality Management System to Education of International Students, Procedia - Social and Behavioral Sciences 215, 9-13.

Mingaleva Z. (2013), Ethical Principles in Consulting, Procedia - Social and Behavioral Sciences 84 1740 – 1744, doi: 10.1016/j.sbspro.2013.07.024

Pliner N., Thrall J., Boland G., Palumbo D. (2004), Experience-based consulting: The value proposition, Journal of the American College of Radiology, Volume 1, Issue 11, November 2004, 811-814.

Pop L. D. (2016), Study on Creating a Simplified Model of Quality Management System in a SME from the Central Region of Romania, Procedia Technology, Volume 2, 1084-1091.

Srinivasan R. (2014), The management consulting industry Growth of consulting services in India: Panel discussion, IIMB Management Review 26, 257-270.

Wright C., Sturdy A. & Wylie N. (2012). Management innovation through standardization: Consultants as standardizers of organizational practice, Research Policy 41, 652–662. doi:10.1016/j.respol.2011.12.004

FMEA APPLICATION IN RISK MANAGEMENT AS RESPONSE TO THE ISO 9001:2015 REQUIREMENTS

Sanja Markovic[*1], Jelena Ruso[1], Ana Horvat[1]
[1]University of Belgrade, Faculty of Organizational Sciences
[*]Corresponding author, e-mail: sanjamarkovic035@gmail.com

Abstract: *The requirements in newest revision of the quality management standard ISO 9001 are related to risk management. For organizations in transition phase there is the challenge of meeting these requirements. Therefore explored was the identification of the critical risk points in telecommunication service using quality method Failure Mode and Effect Analysis (FMEA). The case study regarding spreading failures by causes was performed during the period of one year in Telecom Serbia Company. Findings of the case study on the application of FMEA has shown that this is a good model for performing risk assessment in telecommunication industry in accordance with quality management system requirements. Corrective actions were proposed for detected failures. Implementation of this actions leads to a greater quality of telecommunications service.*

Key words: *FMEA, ISO 9001, risk management, telecommunication service, Risk Priority Number*

1. INTRODUCTION

As an International Standard, ISO 9001 (Quality management systems - Requirements) is subject to review on a regular basis. When considering the 2015 revision, the committee responsible decided that some changes were necessary, such as Clauses related to “risk”. Risk-based thinking is something we all do automatically and often sub-consciously to get the best result. The concept of risk has always been implicit in ISO 9001 - this revision makes it more explicit and builds it into the whole management system. In previous editions of ISO 9001, a clause on preventive action was separated from the whole. Now risk is considered and included throughout the standard. For example, In Clause 6 the organization is required to take action to identify risks and opportunities, and plan how to address the identified risks and opportunities (ISO 9001:2015).

Therefore the paper will focus on widely used quality method (Failure Mode and Effect Analysis - FMEA) and its application in services. In that manner, we try to identify risk points in enterprise in order to prevent and eliminate defects in service processes. FMEA is a step-by-step approach for identifying all possible failures in a design. The model fulfils the basic requirements of ISO 9001:2015 reference in terms of identification of the main and auxiliary processes.

The aim of paper is to identify the critical risk points in telecommunication service and, in accordance with that, suggest preventive and corrective measures. The first part of paper talks about literature review and FMEA method. The second part of article is focused on research methodology and third part is dedicated to case study on the application of FMEA method in telecommunication services in Serbia, more precisely Telecom Serbia Company. In this paper we have a detailed description of how the estimates were awarded and how we get risk priority number (RPN) for definition of the necessary corrective actions and their priority such as preventive measures to management risk.

At the end we discus about what we have done through the research and about practical solutions that could find their application in the future.

2. LITERATURE REVIEW

FMEA is the best analytical method, because allow for establishing links between causes and effects of defects, as well as searching, solving and withdrawing the best decisions concerning applying

proper action" (Dudek-Burlikowska, 2011). FMEA was developed for the US Army as an official analysis methods. Military Procedure MIL-P-1629, entitled "Procedures for Performing a Failure Mode, Effects and Criticality Analysis" originally dates from 1949. (The International Marine Contractors Association, 2002).

"FMEA is a methodology for analyzing potential reliability problems early in the development cycle where it is easier to take actions to overcome these issues, thereby enhancing reliability through design. FMEA is used to identify potential failure modes, determine their effect on the operation of the product, and identify actions to mitigate the failures. A crucial step is anticipating what might go wrong with a product". While anticipating every failure mode is not possible, the development team should formulate as extensive a list of potential failure modes as possible. The early and consistent use of FMEA in the design process allows the engineer to design out failures and produce reliable, safe, and customer pleasing products . FMEA does also capture historical information for use in future product improvement" (Huber and Mraz, 2005).

All products and processes follow these ten steps of FMEA method (McDermott et al., 2009):

- Review the process or product;
- Brainstorm potential failure modes;
- List potential effects of each failure mode;
- Assign a severity ranking for each effect;
- Assign an occurrence ranking for each failure mode;
- Assign a detection ranking for each failure mode and/or effect;
- Calculate the risk priority number for each effect;
- Prioritize the failure modes for action;
- Take action to eliminate or reduce the high-risk failure modes and
- Calculate the resulting RPN (Risk Priority Number) as the failure modes are reduced or eliminated.

FMEA is very popular risk assessment method which was the subject of many articles within different topic (Fazlovic and Karahmetovic, 2012, Mentes and Ozen, 2015; Mock et al., 2002; Ookalka et al., 2009; Rhee and Ishii, 2003; Tavne et al., 2010). For instance, Fazlovic and Karahmetovic (2012) analyzed internal processes in one of the telecom operators in the market of Bosnia and Herzegovina by FMEA methodology, and gave suggestions for quality improvement. They analyzed the following package dimensions: voice services, data transmission services and terminal equipment. Also, Vriezekolk et al.(2011) are one of those who recommended FMEA as a way to analyse telecom service model in order to perform a risk assessment in crisis management where is essential knowing their service availability risks. Similar to previous authors, Pranoto and Nurcahyo (2014) used FMEA to identify the root cause of Network Performance High Speed Downlink Packet Access in telecommunication industry. They used this method „to examine the failure of a potential product or process, evaluate the risk priority, and help determine the appropriate action to avoid the problems that have been identified" in telecommunication industry with the purpose of quality improvement. Gómez Fernández et al. (2016) applied FMEA in a telecommunications company to measure the influence of failures occurrence on losing customers.

Likewise, Zeng and Chun (2010) in China used the same method for risk management analysis within Integrated Management System, that includes OHSAS 18001 (occupational health and safety management), ISO 14001 (environmental management) and ISO 9001 (quality management). The authors showed the application of this method in organizations, where FMEA helps them to identify potential risk problems. They've discovered five major potential risks, including "Roof related falls", "Elevator shaft falls", "Holes in flooring on construction site", "Hit by falling objects", and "Run over by operating equipment" that are graded to be unacceptable, and suggested minimizing them using prevention such as protection.

In addition, in paper written by Xiao et al. (2011) „the minimum cut sets theory has been successfully incorporated into the traditional FMEA for assessing the system reliability in the presence of multiple failure modes". They „expanded the definition for RPN by multiplying a weight parameter to characterize the importance of the failure causes or components. Following the weighted RPN, the utility of corrective actions is improved".

3. RESEARCH METHODOLOGY

Telecom Serbia Belgrade is a modern, fully local telecommunications company that has the leader role in the field of home and mobile telephony, Internet and multimedia, both in Serbian and in the region, for the past 18 years (Telecom Serbia, 2016). The subject of FMEA analysis refers to the executive unit Jagodina and includes spreading failures by causes during the period January-December, 2010. The total number of observed failures is 129, sorted by the causes. The data were obtained in the company Telecom Serbia, executive unit Jagodina, with the approval of the General Director, at the request of a competent person for maintenance and repair. Original data contains objects grouped by interference, with defined causes of interference for each object, numerically and by percentage displayed eliminated interference as well as other parameters on which the estimate RPN (Risk Priority Number) was configured. Following the example of McDermott (2009), we estimated the next parameters:

- Severity (S)—The consequence of the failure should it occur.
- Occurrence (O)—The probability or frequency of the failure occurring.
- Detection (D) —The probability of the failure being detected before the impact of the effect is realized.

In order to help defining these parameters, some values were calculated:

• mean time between failures (MTBF);

$$MTBF=t/r \tag{1}$$

• failure intensity (ƛ);

$$ƛ = 1 / MTBF \tag{2}$$

• the total time of inactivity (Down Time) -The average duration of the interference.

Assessment of the probability of occurrence and failure severity were obtained using Ford's scale (Ford, 1996), while the estimate of the probability of detecting failure was based on the opinion of experts (Reliability and Risk Analysis, 2016). RPN is a mathematical product of numerical score for Severity, Occurrence and Detection:

$$RPN = Severity \times Detection \times Occurrence \tag{3}$$

It is used to determine the priority items that require additional quality planning or action.

4. CASE STUDY

In order to estimate risk priority number for further risk management, failure Severity-S, likelihood of Occurrence-O, and probability of Detection-D of every failure effect was measured.

The assessment of probability of Detection-D was obtained using the opinion of experts. The question that was asked during the visit to the company and interview with experts was: "What is the probability of detecting a system failure before the service user observes it and reports the malfunction? According to the submitted scale, where the scope of score ranges from 1-10, rate the probability of

detection while having in mind that the score is inversely proportional to the possibilities of the detection capabilities, so that failures with the least possibility of detecting will have highest score, and vice versa.

Probability of Occurrence-O was based on the MTBF (Mean Time Between Failure) value, which represents the ratio of total time in which the failures are observed (in this case represents a period of one year) and the number of failures in the stated period for every interfered object.

Example: In the case of ADSL user equipment, where the fault was observed in incorrect connecting, the number of removed interference would be 23 over a period of one year, or 8760h, where the ratio of this two would give us the mean time between failures, MTBF = 8760/23 = 381. Then, using Ford's scale we can determine that the value belongs to the range corresponding the score of 7 on given scale. Part of the table that relates to the mentioned interference and the probability of occurrence are given below.

Table 1: Annual report on the interference of 2010, the executive unit Jagodina (Excerpt 1)

Interfered Object	**Cause of failure**	**Interference removed**	**MTBF**	***Occurrence***
ADSL user equipment	Incorrect connecting	23	381	7

Assessment of the severity of the effects of failure (Severity-S) was obtained based on DT (Down Time), is total interval of failure, which represents the average duration of removed interference.

Example: Assessment of the severity of failure, calculated on the same case which was taken for assessing the probability of occurrence, is calculated using total time of inactivity which represents the average duration of removed interference, which in this case is 68 min, or 1.33h. By using Ford's scale it is determined that the severity score is 6. Part of the table containing mentioned information is provided below.

Table 2: Annual report on the interference of 2010, the executive unit Jagodina (Excerpt 2)

Interfered Object	**Cause of failure**	**Average duration of interference removal**	**DT**	***Severity***
ADSL user equipment	Incorrect connecting	68	1,33	6

In cases where the scale does not precisely define boundary between grade 5 and 6; 6 and 7; 7 and 8, the value which is closest to the inactive time (DT) was chosen.

Below is part of the FMEA worksheet that contains information on ways of failure, failure descriptions, the causes of failure, as well as the assessment of failure severity, probability of occurrence and the probability of detecting any effect of failure. Based on those values the estimate RPN was configured and preventive measures that could forestall failure occurrence or soften its effects and accelerate the possibility of detection were proposed.

Table 3: FMEA worksheet

Object	**Failure Description**	**Cause of failure**	**S**	**O**	**D**	**RPN**	**Preventive measures**
ADSL user equipment	User equipment	Inadequate equipment	6	4	7	168	Mandatory application and submission of procedure which defines the types of equipment.
ADSL user equipment	User equipment	Incorrect configuration	6	6	7	252	Testing the equipment before the mounting.
ATC	Commutation equipment	Age of equipment	6	8	3	144	Recycling and disposal of obsolete equipment in accordance with the Law and regulations.

Base station	Wireless network	Loss of power	5	7	4	140	Introduce greater quality equipment control.
Box	Wireless network	Equipment quality	5	3	10	150	Introduce greater quality equipment control.
FM	Wireless network	Unknown	6	2	10	120	Periodic inspection and maintenance of equipment in accordance with the instructions for maintenance.
Main hub	Wireless network	Poor quality construction	6	4	10	240	Training employees for work on field.
External copy	Wireless network	Cable sheet damage	6	9	10	540	Protect cables by placing insulation and protective equipment.
Telephone booth	Group fault on Telecom equipment	Third party	6	2	5	60	Periodic inspection and maintenance of equipment in accordance with the instructions for maintenance.
Internal copy	Wireless network	Reconstruction of the access network	6	2	10	120	Informing users about the reconstruction period.
Main cable	Wireless network	Creeping cable	4	2	10	80	Protect cables by placing insulation and protective equipment.
Distribution cable	Wireless network	Incorrect maintenance	4	2	10	80	Application of instructions for maintenance and staff training.
Cable hub	Wireless network	Severe weather	6	3	10	180	Protect machinery and equipment from severe weather by placing the appropriate protective box.
Network Termination (NT1)	User equipment	Unprofessional handling of NT ending	4	2	7	56	Application of instructions for use and training.
PCM	Wireless network	Power fallout	6	7	10	420	Introduce more frequent control of telecommunication installations

Based on the given FMEA worksheet, in which RPN is calculated, priority of corrective actions is determined. Failures with the highest RPN value have priority in the implementation of corrective actions. Sorting of failures by RPN was done in descending order, and after completion it came with the following conclusion: from the total number of failures that have been analyzed, which in this case is 129, 32 failures have RPN greater than 400, which represents about 25% of the total number of failures, while as many as 103 failures have RPN greater than 125, indicating that nearly all failures have an extremely high risk level.

While analyzing failures with the RPN higher than 400, which represent an unacceptable risk, following corrective actions were established (sorted by the priority of actions):

- Protect cables by placing insulation and protective equipment.
- Recycling and disposal of obsolete equipment in accordance with the Law and regulations.
- Informing users about the reconstruction period.
- Protect machinery and equipment from severe weather by placing the appropriate protective box.
- Periodic inspection and maintenance of equipment in accordance with the instructions for maintenance.
- Application of instructions for maintenance and staff training.
- Introduce more frequent control of telecommunication installations.

5. CONCLUSION

The subject of research is the analysis of maintenance in telecommunication company Telecom Serbia, the executive unit Jagodina, using FMEA method, with the goal of continued administration of potential risks as part of the international standard ISO 9001: 2015.The subject of analysis were failures and interferences of the system, along with their causes, that occurred during the 2010s. All the basic data used for the actual implementation of the method were collected during the visit to the company. Based on the description of failures and data on the manner and cause of the failures estimates were made for the severity, probability of occurrence and detection of any failure effects. Using these parameters RPN was calculated, sorted in descending order, and used to determine the priority of corrective actions, which were defined by the completion of the analysis.

The limit which represents an unacceptable risk in the system was determined, and failures in which the RPN exceeded defined limits were specifically discussed, as well as the actions that affected them. Corrective actions that have been proposed to accelerate the ability of detection, prevent failures in system or soften their effect, are applicable to all parts of the observing system and can lead to strengthening the position of Telecom Serbia in the market and achieve higher customer satisfaction by increasing the reliability and quality of a major part of their services.

Certainly the most important action to implement is the protection of cables used for installing devices that clients use. Furthermore, same protection should be built on network installations, by placing protective tapes that will prevent damage to the cable sheath and other damage that can lead to cable breaks and therefore the loss of flow of signals necessary for the provision of services. Recycling and disposal of old equipment is also a measure with a high level of priority, because it can cause additional costs and lead to customer dissatisfaction, while satisfied customer is one of the most important goals of the company. It is important to constantly check the accuracy of the equipment, and if found to be worn, act in accordance with the law that applies to recycling, recycle and dispose it properly in order to prevent its unintended use.

If it is a period of reconstruction of telecommunication facilities, or any type of activities that can lead to malfunctions or even downtime, it is necessary to promptly inform customers and, if possible, provide them with an alternative to be able to access the network.

Weather conditions are very common occurrence that may cause adverse effects to the equipment which is not protected well when installed. If the devices used for receiving signals and other switching equipment are located outdoors, it is necessary to put them in appropriate protective box resistant to any influences from the environment (including natural disasters, as well as physical damage).

As already mentioned above, the equipment should be periodically reviewed and maintained in order to maintain in proper condition. Because of this, it is necessary to have instructions for maintenance, that the employee will follow and which will contain regulated ways for the reviewing and maintaining as well as recommended frequency of inspection. Likewise, the manual should be also delivered to users when their product is installed, and they are expected to follow the same. Employees must go through the proper training to be competent with appropriate knowledge, skills and experience to perform duties of providing all kinds of services. This applies to all, from those who work in the field, to operators and workers who are in direct contact with users.

And finally, quality control of devices customers use to acquire their services, as well as control of telecommunication facilities that enable them to do so is of crucial importance. The Law regulates the actual process and it is necessary for it to be performed by a professional team, at least twice a year, in order to reduce failures to the lowest possible level.

REFERENCES

Dudek-Burlikowska, M. (2011). Application of FMEA method in enterprise focused on quality. *Journal of achievements in Materials and Manufacturing Engineering*, *45*(1), 89-102.

Fazlovic, S., Karahmetovic, N. (2012). Quality management of assembled service on telecommunication market of Bosnia and Herzegovina.*16th International Research/Expert*

Conference "Trends in the Development of Machinery and Associated Technology" TMT 2012, Dubai, UAE, 10-12 September 2012

Ford Motor Company. (1996). Failure Mode & Effect Analysis-Handbook Supplement for Machinery.

Gómez Fernández, J. F., Márquez, A. C., & López-Campos, M. A. (2016). Customer-oriented risk assessment in network utilities. Reliability Engineering and System Safety, 147, 72–83. doi:10.1016/j.ress.2015.11.008

ISO 9001:2015 Quality management systems — Requirements

Mentes, A., & Ozen, E. (2015). A hybrid risk analysis method for a yacht fuel system safety. *Safety Science,* 79(November 2015), 94-104. doi:10.1016/j.ssci.2015.05.010

Mikulak, R. J., McDermott, R., & Beauregard, M. (2008). *The basics of FMEA*. CRC Press.

Mock, R., Möhle, F., & Fischer, A. (2002). Risk analysis related issues of IT-systems: Case studies in review. *PSAM6—Probabilistic safety assessment and management, San Juan, Puerto Rico (USA), 2*, 1885-1890.

Mraz, M., & Huber, B. (2005). FMEA-FMECA. *Rep. Ljubljana: University of Ljubljana.*

Ookalkar, A. D., Joshi, A. G., & Ookalkar, D. S. (2009). Quality improvement in haemodialysis process using FMEA. *International Journal of Quality & Reliability Management*, *26*(8), 817-830.

Pranoto, S., & Nurcahyo, R. (2014). Implementation of integrated system Six Sigma and importance performance analysis for quality improvement of HSDPA telecommunication network and customer satisfaction. In *Proceedings of the 2014 International Conference on Industrial Engineering and Operations Management*. Bali, Indonesia, January 7 – 9, 2014

Reliability Analysis and Risk. Laboratory for Operations Research. Faculty of Operations Research. Faculty of Organizational Sciences. Belgrade, Serbia. Available at http://laboi.fon.bg.ac.rs/ *(accessed 20 April 2016).*

Rhee, S. J., & Ishii, K. (2003). Using cost based FMEA to enhance reliability and serviceability. *Advanced Engineering Informatics*, *17*(3), 179-188.

Tavner, P. J., Higgins, A., Arabian, H., Long, H., & Feng, Y. (2010). Using an FMEA method to compare prospective wind turbine design reliabilities. In *European Wind Energy Conference and Exhibition 2010, EWEC 2010* (Vol. 4, 2501-2537). Sheffield.

Telecom Serbia (2016). Available at https://www.mts.rs/ *(a*ccesses on 20 April 2016)

The International Marine Contractors Assotiation (2002). Guidance on Failure Modes & Effects Analysis.

Vriezekolk, E., Wieringa., R., Etalle, S. (2011). A New Method to Assess Telecom Service Availability Risks. *Proceedings of the 8th International ISCRAM Conference – Lisbon, Portugal, May 2011*

Xiao N. et al. (2011). Multiple failure modes analysis and weighted risk priority number evaluation in FMEA. *Engineering Failure Analysis 18 (4) 1162–1170*

Zeng, S. X., Tam, C. M., & Tam, V. W. (2010). Integrating safety, environmental and quality risks for project management using a FMEA method. *Engineering Economics*, *66*(1).

QUALITY OF SOCIAL RESPONSIBILITY ACTIVITIES AND STAKEHOLDERS NEEDS IN SERBIAN EDUCATIONAL INSTITUTIONS

Bojana Lukić*[1], Maja Glogovac[1], Nedeljko Živković[2]
[1]Faculty of organizational sciences, University of Belgrade, Serbia
*Corresponding author, e-mail: maja.glogovac@fon.bg.ac.rs

Abstract: *Although many authors point out the multiple benefits of social responsibility for not-for-profit organizations, there is no many research about attitudes of educational institutions of such activities. The survey conducted in this study aims to determine the importance as well as the level of quality of social responsibility behavior of educational institutions in Serbia. Social responsibility activities are observed through three groups: charity work (donations and providing free education), getting involved in research beyond the curricula; cooperation with the corporate/business community. When it comes to the all of the social responsibility activities, results indicate a satisfactory level of the respondents' consciousness, but the implementation degree is not seen as high. The results are compared with results of such research in educational institutions of other countries Hence, the analysis can be useful for social responsibility - related positioning of the institutions and for the revealing the level of their social responsibility consciousness.*

Keywords*: social responsibility, educational institutions, quality and importance of social responsibility*

1. INTRODUCTION

Social responsibility refers to ensuring the success of a business by the inclusion of social and environmental considerations into a company's operations (Chopra & Marriya, 2013). Social responsibility is about values and standards by which a business operates and commitment of a business to behave ethically, operate legally and contribute to socio-economic development while improving the quality of life of its employees and their families as well as local community and society at large (Mang'unyi & Chege, 2014).

Organizations around the world, and their stakeholders, are becoming increasingly aware of the need for and benefits of socially responsible behavior (ISO 26000:2010). The perception and reality of an organization's performance on social responsibility can influence, among other things, its stakeholders which can also reflect the quality management system of the organization. Especially in view of changes of ISO 9001:2015, all the stakeholders have to be taken into consideration when designing quality management system. The international standard ISO 26000 provides guidance on the underlying principles of social responsibility, recognizing social responsibility and engaging stakeholders, the core subjects and issues pertaining to social responsibility and on ways to integrate socially responsible behavior into the organization.

In the last decades social responsibility has forcefully and irreversibly become a part of the corporate actions of a growing number of companies and continues to provoke the interest of governments, international institutions, scientists and researchers (Slavoval & Bankovall, 2015). As such, the notion of social responsibility is becoming more prevalent in the curricula of universities also (Elobeid et al., 2016). However, according to Idowu (2008), researchers in the field of social responsibility have tended to concentrate more efforts on the social responsibility of profit seeking corporate entities. Unfortunately this does not appear to be the case when it comes to the social responsibility of not-for-profit (NFP) corporate entities such as educational establishments (schools, colleges and universities) and other NFP entities that play equally important roles in modern economies. After that, Ojha (2012) points out that social responsibility is becoming more central to the societal expectations from commercial organizations, with the possibility that spending a certain percentage of corporate income on societal welfare is likely to have legislative sanction. Education is the most powerful weapon which can be used to change the world and to help in lighting the darkness of the society (Singh et al., 2015). Collaboration of social responsibility with the core education will require a change in the mindset of all stakeholders in realizing the importance of rigorous evaluation of educational programs and willingness to alter policies and practices in the light of the findings. The desire to change the current state of education and of the current less-than-adequate regard for the impact of business on larger societies are, however, prerequisites (Nandi, 2013).

Certain academic institutions have recognized the activities which they consider to be important in their work. For example, Bundaleska and Dimitrova (2012) have pointed out that in Macedonia there is a lack of implementation of social responsibility activities, but have also made suggestions about which activities could be conducted in order to raise the level of social responsibility. Some of those activities are: designing the curricula in such a way that challenges students to evaluate business behavior along environmental, social, and ethical dimensions; establishing Social Responsibility Centers within schools and universities; raising awareness and understanding of social responsibility via various events, seminars, conferences, trainings, etc; valuing student effort trough awards for student projects and activities related to social responsibility and other. In Kenya, for example, a research by Mang'unyi and Chege (2014) has found that among the interviewed employees the statement social responsibility improves the school reputation had 75% of the responses being neutral. Most schools are not explicit in their social responsibility programs. However 15.625% strongly agreed and 9.375% agreed to the statement. The statement on social responsibility increasing employee motivation and retention was put and 84.375% of the responses agreed. Finally, 84% agreed and 16% strongly agreed that social responsibility protects resources on which the school depends. These resources include members of the community, the physical environment and employees. McDonald and Liebenberg (2006) have conducted a study to determine the level of understanding what social responsibility is and how it is perceived among employees in South Africa. They have found that there is no common understanding of social responsibility in South Africa amongst participants, or a common appreciation of the need for social responsibility. Participants generally confused social responsibility with human resources issues and felt that employee benefits and employee assistance programs should be primary areas of social responsibility focus within the organization. There was also a general tendency amongst participants to assume that social responsibility was more about spending money, than investing in a socially responsible manner

Besides the educational institutions that have only recognized the importance of social responsibility and are yet to implement social responsibility activities in their field, in some countries, there are educational institutions that are already implementing social responsibility activities. Some of those countries are listed below:

United Kingdom (Idowu, S.O. 2008):

- Widening participation;
- Developing and communicating performance on sustainable developments;
- Contributing both to national and international systems of university education;
- Managing the economic, social and environmental impacts of their activities;
- Take into account the interests of all stakeholders and act as good citizens;
- Joining Business in the Community (BitC) as an initial step;
- Responding to social needs in terms of education and Innovation;
- Engagement with corporate bodies through staff;
- Providing a more effective community service;
- Challenging, inspiring and supporting students to grow;
- Sustaining and adding value to country's culture, economy and the natural environment;
- To manage and govern itself with responsibility and sensitivity.

Kenya, Busia County (Mang'unyi & Chege, 2014):

- Provision of sanitary towels to 'unlucky' girls at school;
- Donation of clothing;
- Free education to needy bright children;
- Community use of school resources, e.g. playing ground, bore holes, school bus, electricity, etc;
- Subsidized training fees at resource training centers;
- Discussion groups with public schools.

Turkey, Istanbul (Dahan & Senol, 2012):

- Donation of their income for research;
- Free lessons for high school graduates;
- Free sports schools;
- Education made available to the poor;
- Courses, education centers etc.

Upon examining the data shown above it is concluded that these activities cannot be all observed as a whole so for the purpose of this paper they shall be divided in to three sub groups:

- Charity work (donations and providing free education);
- Getting involved in research beyond the curricula;
- Cooperation with the corporate/business community.

2. THE FRAMEWORK OF THE RESEARCH

2.1. The aim of the research

Although many authors emphasize the multiple benefits of social responsibility for not-for-profit organizations, very few have dealt with the survey of attitudes of educational institutions of such systems. The survey conducted for this study aims to determine the importance as well as the level of social responsibility behavior of educational institutions in Serbia. The results could be compared with results of such research in educational institutions of other countries. This analysis can be useful for social responsibility - related positioning of the institutions and for the revealing the level of their social responsibility consciousness.

2.2. Research questions

Taking into account the low level of social responsibility behavior research, there are two main research questions in this paper:

- Research question 1 – what is the level of social responsibility activities importance from the educational institutions point of view;
- Research question 2 – what is the level of social responsibility activities implementation the educational institutions.

2.3. Research instrument and sample characteristics

The research in this paper is conducted using the questionnaire. Through 20 questions, teachers expressed their attitude toward the importance and the level of implementation of social responsibility activities in their institutions. The Likert scale containing five levels was used for both the answers – the importance of social responsibility activities and the level of implementation of these activities. On the basis of the relevant literature, the elements that make social responsibility behavior involved in the questionnaire are:

- Help provided for students in welfare class;
- Institution involvement in any type of charity work;
- Students informing about the social issues trough the curricula;
- Staff engagement in some type of socially responsible activities;
- Students engagement in some type of socially responsible activities;
- Staff engagement in research that enables you to be socially responsible;
- Institution cooperation with other institutions on a wider scale (national, international) in the field of social responsibility;
- Institution cooperation with the business sector on social responsibility activities;
- Students opportunities to further their education trough the cooperation between the academic institutions and the business sector;
- The degree of social responsibility contribution to the reputation of academic institutions.

In the view of the standard ISO 9001 as well as the standard 26000, all the stakeholders should be taken into account when designing quality management system and social responsible activities. That is why several stakeholders are included into questions within this research.

The questionnaire was sent by e-mail to teachers of primary schools, high schools and faculties. From 50 questionnaires sent, we received and processed 35 questionnaires that were correctly filled out. The responding rate is 70%. The sample structure is given in Figure 1.

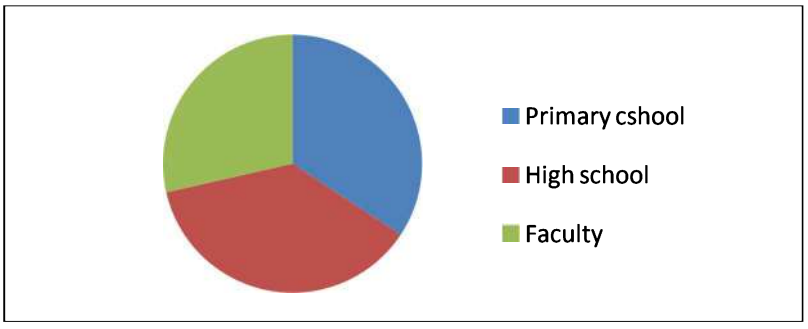


Figure 1: Sample structure

3. RESULTS

Ten key social responsibility activities are considered in this paper and results about the importance as well as the level of implementation of each activity are given and explained below.

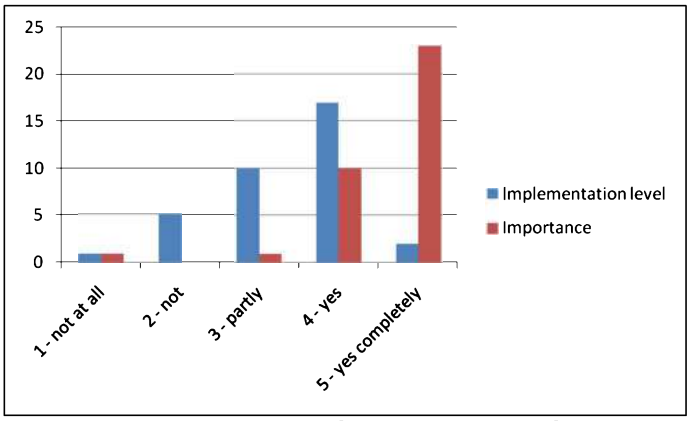


Figure 2: Help provided for students in welfare class

When it comes to the help provided for students in welfare class, it can be seen that there is a high level of recognition regarding the importance of providing help to students in welfare class. 28,5% of the teachers agree that help should be provided, and 65,7% absolutely agreed. When it comes to their opinion on if help is actually being provided, 48,5% of them consider that some form of help is provided, while 14,3% chose to answer with "no" and 1 with "not at all".

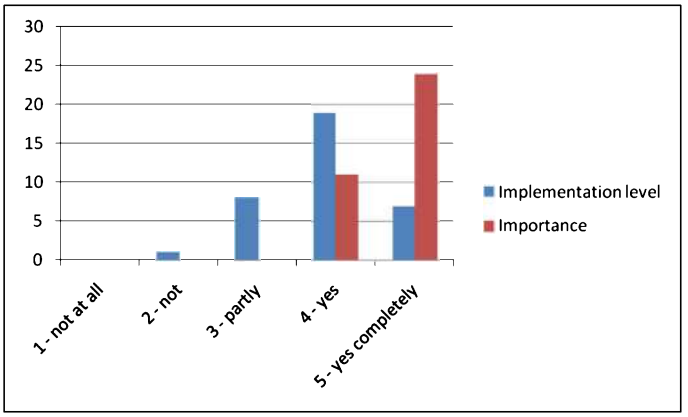


Figure 3: Institution involvement in any type of charity work

When asked about the school's involvement in any type of charity work, 19 of them consider that the school does some type of charity work, 18 answered with "partly", 7 with "yes completely", while one participant chose "not" as their answer. Similar as in the previous question, most of the participants of the survey recognized the importance of charity work, 68,6% of the participants strongly agreed with the statement that the institutions should be involved in charity work and 31,4% agreed with the statement.

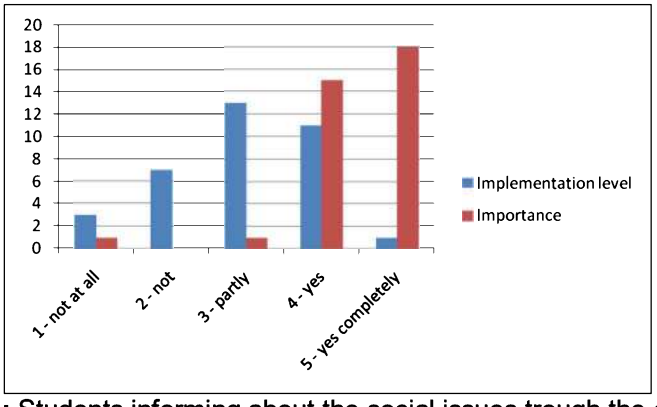


Figure 4: Students informing about the social issues trough the curricula

Regarding the informing students of social issues trough the curricula 37,1% of the participants consider the students to be partly informed, 31,4% consider the students to be informed, 20% found that the students are not informed, and 8,6% answered with "not at all". Only one of the participants answered with "yes, completely". As far as their views on the importance of the matter, 51,4% teachers completely agreed that students should be informed about the social issues trough the curricula, 42,9% agreed with the statement, and 2,9% of the participants answered with "partly" and "not at all" each.

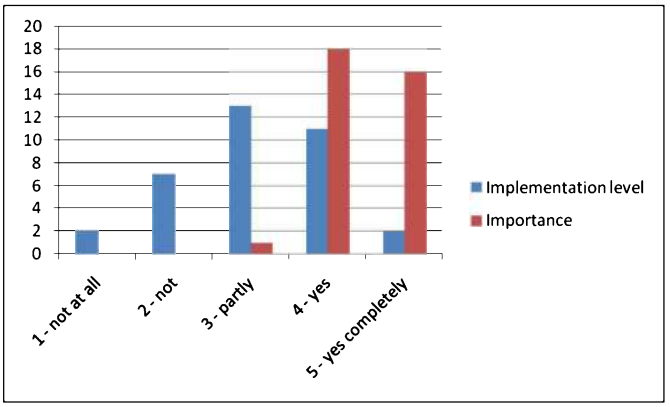


Figure 5: Staff engagement in some type of socially responsible activities

When asked about the extent to which the staff is involved in social responsibility activities 37,1% of the participants answered with "partly", 31,4% with "yes", 20% answered with "no", and options "not at all" and "yes, completely" were each chosen by 5,7% of the participants. On the other hand, when it comes to the importance of staff involvement in social responsibility activities, only 2,9% partly agreed with the statement, while 45,7% agreed completely and 51,8% answered with "yes".

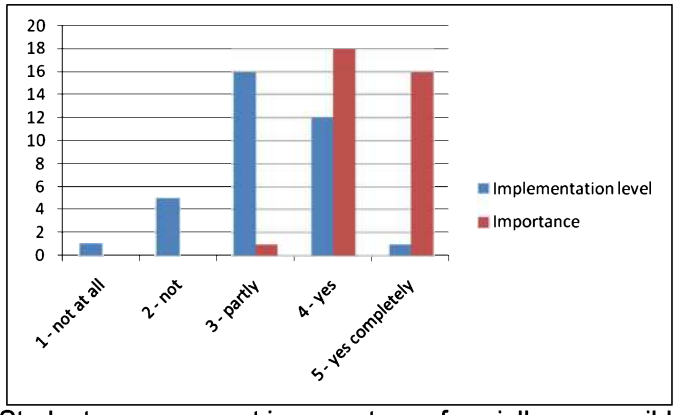


Figure 6: Students engagement in some type of socially responsible activities

Most participants consider their students engagement in social responsibility activities to be neutral, 34,3% consider them to be involved, 14.3% answered with "no" and options "not at all" and "yes, completely" were chosen by 2,/9% of the teachers. But only 2.9% consider this to be of neutral importance, while 45,7% thought this to be completely relevant issue and 51,4% answered with "yes" when asked if students should be involved in social responsibility activities.

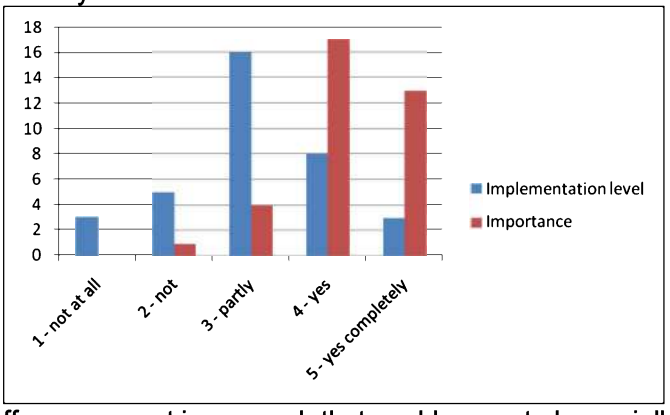


Figure 7: Staff engagement in research that enables you to be socially responsible

When asked about their involvement in research that enables them to be socially responsible, 45,7% of them were neutral on the matter, 22,9% said that they are involved in such research, 14,3% answered with “no”, while 8.6% of the participants answered with “not at all” and “yes, completely” each. 2,9% of the participants don’t consider this to be an important issue, 11,4% are neutral on the subject, 37,1% completely agreed that the issue is relevant and 48,6% answered “yes” when asked if such research is important.

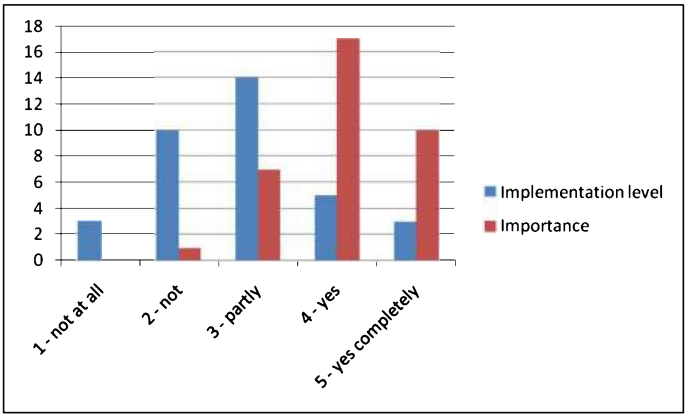


Figure 8: Institution cooperation with other institutions on a wider scale (national, international) in the field of social responsibility

40% of the teachers found that the institution they work for is neutral on the subject of cooperation with other institutions, 28,6% think that such cooperation does not exist, 8,6% thought that there is absolutely no cooperation, 14,3% think that there is some cooperation and 8,6% find that cooperation with other academic institutions is satisfactory. When asked about the importance 2,9% do not think such cooperation should be conducted, 20% are neutral when it comes to such cooperation, 28,6% find it absolutely important and 48,6% agree that it should be implemented.

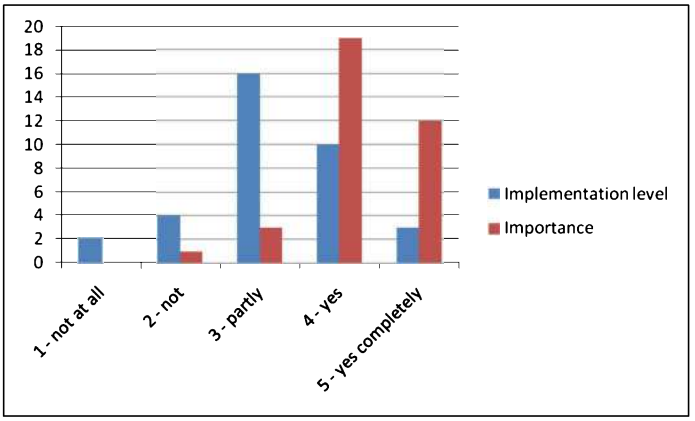


Figure 9: Institution cooperation with the business sector on social responsibility activities

Most of the teachers find their school to be neutral in cooperating with the business sector (45,7%), 28,6% thought that some form of cooperation exists, 11,4% think that there is no cooperation, 5,7% said “not at all” and only 8,6% thought that the level of cooperation is high. When it comes to the importance of such cooperation, only 2,9% don’t find such cooperation to be necessary 8,6% are neutral on the matter, 34,3% find such cooperation is absolutely important while 54,3% find it to be important.

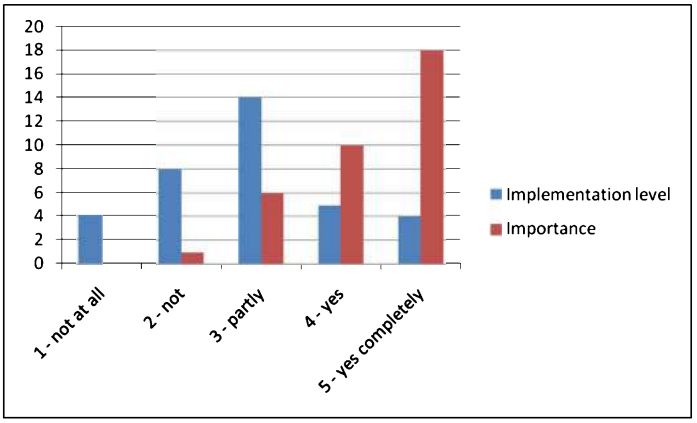


Figure 20: Students opportunities to further their education trough the cooperation between the academic institutions and the business sector

When asked if their students have opportunities to further their education trough cooperation with the business sector, 40% answered with "neutral", 22,9% answered with "no", 11,4% said "not at all", 14,3% of the teachers thought that there are opportunities for students and 11,4% answered with "yes, completely". On the importance of students furthering their education with such cooperation, 2,9% think that this is not important, 17,1% were neutral on the issue, 28,6% think that furthering students education in such way is important and 51,4% completely agree that this type of furthering students' education is important.

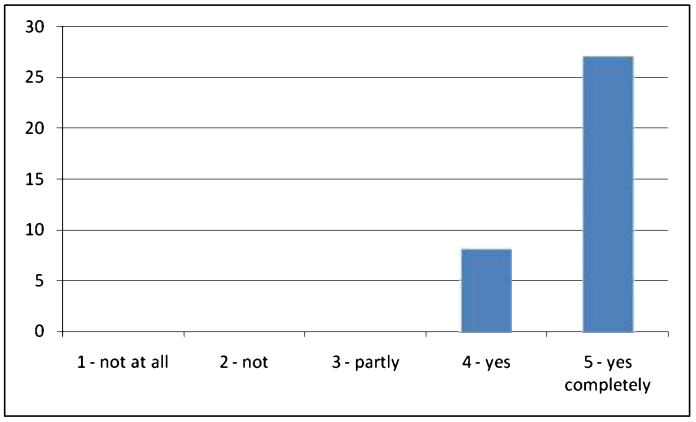


Figure 31: The degree of social responsibility contribution to the reputation of academic institutions

Finally, when asked if they consider if social responsibility activities contribute to the reputation of academic institutions, all participants agreed, with 22,9% answering with "yes" and the rest (77,1%) answering with "yes, completely".

4. CONCLUSION

The idea of this paper was to explore the quality of various social responsibility activities in Serbian education institutions and the key stakeholders' level of awareness of the importance of social responsibility in today's environment. Our biggest restriction was the small sample of teachers we had the opportunity to distribute the survey to. In order to have a more comprehensive understanding of the general state in the country a more extensive research is necessary, for which the authors of this paper did not have the appropriate conditions. Regarding the results of the research, we have concluded that on almost every issue, the level of implementation is mostly on a medium level while the teachers agree that all of these issues are of high importance.

First two questions, which fall into the first category (Charity work – donations and free education) show that most schools do have some type of social responsibility activities that are correlated to students in welfare class. The questions of the second category (getting involved in the research beyond the curricula), most of the schools are in the "neutral" category on every type of the activities that the poll suggested, but the level of importance was estimated as high by almost all teachers. From this we can conclude that while the schools perhaps do not have the means to conduct such activities, the benefits of this type of activities are recognized among the staff. The questions from the third category (cooperation with the corporate/business community) also showed that most schools have a neutral stand on the subject, but unlike the previous

category, less teachers consider this to be a valuable asset to both the schools and the students, seeing as some teachers when asked if they consider such activities have a positive effect choose the "neutral" option or simply answered "no". This might be a result of including primary school teachers in the survey, but the authors considered that the poll would not be as representative without their input on all issues.

From our research we can conclude that the academic institutions in Serbia can be placed in to the medium category when it comes to the implementation of social responsibility activities in education. We are yet to reach the level of implementation that the schools in UK have, but we have certainly surpassed the level that schools in Kenya for example are currently on. The teachers in our country already have a high level of awareness of the importance of social responsibility activities but the mechanisms of their implementation are yet to be developed. As for further academic research on this subject, inquires can be made to address the reasons of low implementation of social responsibility activities when there is a high level of awareness. Also, some suggestions about the ways of implementing social responsibility activities could be used as a guideline to show education institutions how to continue contributing society in new, innovative ways. The Guidance on social responsibility given in ISO 26000 should be incorporated into the design of organizations' activities that would direct them to include needs of all the relevant stakeholders.

REFERENCES

Bundaleska, E., & Dimitrova, M., (2012), *The Business Case for Corporate Social Responsibility in Education.* Munich Personal RePEc Archive, Paper No. 41970, Online at https://mpra.ub.uni-muenchen.de/41970/

Chopra, A., & Marriya, S .(2013). *Corporate Social Responsibility and Education in India.* Issues and Ideas in Education, 1(1), 13–22.

Elobeid, D.E., Kaifi, B.A., & Lele, U. (2016). *Corporate Social Responsibility in Higher Education Institutions: The Experience of the College of Business and Economics at Qassim University.* International Leadership Journal, 8(1), 120-143.

Idowu, S.O. (2008). *An Empirical Study of What Institutions Of Higher Education in The Uk Consider To Be Their Corporate Social Responsibility.* Environmental Economics and Investment Assessment II, WIT Transactions on Ecology and the Environment, 108(2008), 263-273.

ISO 26000:2010 - Guidance on social responsibility, International Organization for Standardization, 2010

Mang'unyi, M.S., & Chege, K. (2014). *Challenges Facing the Implementation of Corporate Social Responsibility Programs in Education Sector: A Survey of Private Primary Schools in Busia County, Kenya.* International Journal of Innovative Research & Development, 3(4), 410-425.

McDonald, F., & Liebenberg, J., *The Perceptions of Employees in a Private Higher Education Institution Towards Corporate Social Responsibility.* SA Journal of Human Resource Management, 2006, 4 (1), 27-35.

Nandi, V.T. (2013). *Corporate Social Responsibility: Relevance In Education and Technology: India.* Proceedings of 6th International Business and Social Sciences Research Conference, 3 – 4 January, 2013, Dubai, UAE

Singh, N., Srivastava, R., & Rastogi, R. (2015). *Lighting the Lamp of Education: Role of Indian Banking Sector towards the Corporate Social Responsibility in achieving Development Goals.* International Journal of Multidisciplinary and Current Research, 17(3), 440-446.

Slavoval, I., & Bankovall, Y. (2015). *Corporate Social Responsibility in Business and Management University Education: the Relevancy to the Business Practices in Bulgaria.* European Journal of Business and Economics, 10(2), 57-64.

WHO IS GOING TO BE MORE INTERESTED IN ISO 50001 CERTIFICATION?

Sanja Kandić
e-mail: kandic.sanja94@gmail.com

Abstract: *This paper's main purpose was to indicate whether the countries in Europe with a higher usage of renewable sources of energy are more interest in getting ISO 50001 certificates and which ones will be more interest than others in the future. Data regarding the usage of wind power and solar thermal power was gathered, together with the data about the number of ISO 50001 certificates in European Union Member countries in order to determine which have the highest renewable sources of energy usage and ISO 50001 certificates, and to see if those two are proportional. Member countries have been split in three groups based on the level of their usage of renewable resources of energy and data about the number of ISO 50001 certificates has been added in order to present those countries which might be interested in ISO 50001 certification most.*

Keywords: *ISO 50001, Europe, renewable energy, renewable sources*

1. INTRODUCTION

Standardization has been working hard to make this world a better place. Therefore, many standards have been developed in order to affect certain areas of life. In the 21st century resources have become a grave issue, threatening to bring economical fall, increase in hunger and many more other disasters. Producing and using energy is another very important issue to be dealt with. A great number of countries does not address these issues as seriously as they should, but some are doing exactly what needs to be done. Having this in mind, this paper will gather the usage of renewable energy sources in the European Union Member Countries and the number of acquired ISO 50001 certificates, in order to present which countries would be most interested in certification in the future and if there is a connection between the renewable energy recourses usage and the number of certificates. Those with a high rate of usage of renewable sources of energy and a number of ISO 50001 certificates that grows year by year, are very important for the future of Europe as a continent and the world as a whole, since they can serve as an example for others and be the leaders in this area.

2. LITERATURE REVIEW

2.1. Overview of the Standard ISO 50001

Using energy efficiently helps organizations save money as well as helping to conserve resources and tackle climate change.(ISO 50001:2011) "Organizations are supported to use energy more efficiently in all sectors by ISO 50001, through the development of an energy management system (EnMS)." The purpose of this International Standard is to enable organizations to establish the systems and processes necessary to improve energy performance, including energy efficiency, use and consumption.(ISO, Requirements with guidance for use, 2011)This standard is, like many others, based on the management system model of continual improvement which allows it to make it easier for organizations to integrate energy management into their system and raise quality to a higher level. "ISO 50001:2011 provides a framework of requirements for organizations." Those are:

- Develop a policy for more efficient use of energy
- Fix targets and objectives to meet the policy
- Use data to better understand and make decisions about energy use
- Measure the results
- Review how well the policy works, and
- Continually improve energy management , according to ISO 50001:2011.

Implementation of this International Standard is primarily intended to lead to reductions in greenhouse gas emissions and other related environmental impacts and energy cost through systematic

management of energy (ISO, Requirements with guidance for use, 2011). It is applicable to all types and sizes of organizations, no matter their geographical state or the cultural and social conditions. The Standard gives general requirements, management responsibilities, energy policy and planning and checking requirements.

Implementation of ISO 500001 is not obligatory. This allows companies to implement this standard simply because of the benefits both they and their environment can receive from it. Unfortunately, the number of companies which do not realize the vast specter of possibilities and benefits this standard offers, is great.

Many organizations think of energy consumption as a fixed overhead that can't be controlled nor reduced (ISO practical guide for SMEs, 2011). "However, energy consumption can be managed and even reduced if the right approach is used." Organizations that take action and implement this standard in the right way make significant energy savings, which lead to financial savings and all that without any additional investments in new machinery or technology.

According to ISO practical guide for SMEs (2011) some of the direct financial benefits of managing energy effectively are:

- Reduction of cost of energy consumption
- Reduction environmental impact from the use of energy and reduced CO2 emissions
- Reduction exposure to rising energy prices
- Reduction availability of utility services
- Reduction production reliability and production output/yields
- Improvement of equipment performance
-

Additional indirect benefits will occur as well, and their value often exceeds the financial value of the saved energy.

Companies can achieve all of the above, without implementing the standard, but that is a less reliable and effective approach. Implementation of ISO 50001 would save a lot of time and energy for a company, and a certificate would use as a proof to all third parties which require it to build cooperation.

The process of certification requires a company to undergo a two stage ISO 50001 audit process of its Energy Management System (EnMS). "The first stage is pre-assessment and the second is certification."
Stage one is conducted with the goal to determine if the mandatory requirements of the standard have been, and are being met. It is also meant to conclude if the management system is capable to proceed further. Stage two determines the effectiveness of the system and seeks confirmation that the management system is implemented and operational (Certification Europe, 2012) .If there have been any problems in phases one and two and if any corrective measures were supposed to be taken, the execution of needed actions is reviewed in the recommendation for certification phase. Certification review and decision follow. Organization's files are reviewed by an impartial panel and the decision whether the organization gets certified is made. Finally, if all turns out to be in sync with the requirements, the organization is issued a certificate.

For an organization to comply with ISO 50001 energy management system's requirements and achieve certification to ISO 50001 it must develop a number of policies, procedures and protocols in relation to energy management (Certification Europe, 2012). Some will be listed here:

- Management responsibility for energy management
- ISO 50001 energy policy
- Energy planning, review and baseline process
- Energy design requirements
- ISO 50001 energy performance monitoring
- ISO 50001 management review etc.

2.2. Renewable energy in the European Union

Renewable energy and its technologies offer long-term solutions regarding the saving of environment , breakthroughs in physics and engineering, as explained by Sorensen B. in *Renewable Energy-physics, engineering, environmental impacts, economics & planning* (2011).
Renewable energy policy in EU has started in 1997, and since then European states have started introducing measures to improve the development of energy from renewable sources such as wind power, solar power, etc. (Pascelia et al., 2016). Implemented policies resulted in rise of renewable sources' share in total primary production of energy from all sources to 24% by the end of 2013(Pasceila M.and all, 2016). Each state of EU contributed differently, since their climate conditions and natural endowments vary.

Eurobserver barometers have been pointing out progress of every Member State of the European Union in the field of renewable energy, since 1998(Eurobserver, 2014). The date shown by the Barometers was regarding solar thermal, solar power, solid biomass, heat pumps and photovoltaic. Comparative analyses regarding electricity production from renewable and head consumption in Member States of the European Union have been presented as well. Additionally, the Eurobserver team publishes bimonthly reports (the so-called thematic barometers) that track and analysis the development of eight renewable energy technologies (wind, solar PV, solar thermal, hydro, geothermal, heat pumps, biomass, bio fuels, biogas) in the EU Member States in the previous year. (Eurobserver, 2014).

In the form of compact and descriptive reports, the barometers help policy makers and other stakeholders understand the developments in all renewable energy sectors in the European Union (Eurobserver, 2014). The barometers describe completed projects, provide policy background information and information specific for each country. Eurobserver's report : " The state of renewable energies in Europe, edition 2014" provides a complete over - view of the twelve renewable sectors.

Only wind power and solar thermal power data will be presented and analyzed in this paper, since those two sources are most popular in building eco houses that produce energy from renewable sources.

2.3. Wind power

The terms wind energy or wind power describe the process by which the wind is used to generate mechanical power or electricity (Office of Energy Efficiency & Renewable Energy, 2015) Wind is a clean source of renewable energy and it produces no air or water pollution, as mentioned in National Geographic's web site.. Since wind is free, there are zero costs of operations after the wind turbine has been built and set. Turbines used to be very expensive, however action has been taken and costs of production are significantly lower now. Many governments offer tax incentives to spur wind-energy development, as well. Turbines can be nearly twenty stories tall with up to sixty meter long of blades. Even though the costs decreased dramatically in the past few years, there are still some issues regarding wind power. To start with, it is important to explain how the wind turbines work. "Wind turbines work opposite of a fan." Instead of using electricity to make wind, like a fan, wind turbines use wind to make electricity (Office of Energy Efficiency & Renewable Energy, 2015).This means that the strength of wind pushes the blades of the turbine, making them spin. This can be dangerous for bats and birds, even though the blades spin slowly. However, turbines kill much less birds and bats than cars, for example. The second problem that arose is the noise and it is followed by the claim that turbines ruin the esthetics of their surrounding due to their design. The biggest problem of wind power usage would be the inconsistency. Although wind is an abundant source of energy, one has to bear in mind that it is not a constant source with a constant supply (Hemami, 2012).

Despite all of these problems, many countries managed to use wind power efficiently, by building wind farms away from settlements, and building a smaller number of turbines on many different locations, so that most of the wind current can be caught.

Regarding wind power, United Kingdom and Germany were leading countries in 2013, as stated in "The state of renewable energies in Europe, edition 2014" report. Developers' resolve to exploit the best wind power purchasing terms before the new renewable energies law reform came into force in August 2014, holds most of the credit for Germany's market success (Eurobserver, 2014). In 2013

the level of UK off shore activity was high with more than 1 out of every 3 MW connected being offshore (Eurobserver, 2014). According to DECC (Department of Energy and Climate Change), the country connected 2 314 MW (1 614 MW onshore and 701 MW offshore), also mentioned in the Eurobserver report from 2014. However the market declined slightly on its 2012 level, when 2 437 MW was connected to the grid. The UK's aim, restated by the Energy Ministry in November 2013, is to install 39 000 MW of offshore capacity by 2030.

Eurobserver report states that the year 2015 was very important for the future development of wind energy and its share in the energy mix planed for 2030. The momentum surrounding the 2020 target has long been ahead of the set target, however the one in 2013 and 2014 was not large enough to reach the intermediate Europe wide target set for 2015.

2.4. Solar thermal power

Solar thermal power plants are designed in a way that allows them to use the heat of rays of sun in order to heat fluids to high temperatures. The fluid is then circulated through pipes so that it can transfer its heat to water and produce steam (U.S. Energy Information Administration, 2015). The technology behind solar thermal power generators is almost the same as the one behind generators that use fossil fuels to produce steam. There are three main types of solar thermal power systems: parabolic trough, solar dish and solar power tower (U.S. Energy Information Administration, 2015).

European Union solar thermal sector for hot water and heat production has proved to be problematic in the past several years. It has been suffering from development problems and in 2013, the market had slipped for the fifth time in a row, like Eurobserver report from 2014 shows. "The Eurobserver survey found out that in 2013 the amount of installed collector surfaces was 13.3% smaller than in 212." Installation figures for solar thermal collectors now resemble those of 2007, and are getting further away from the annual installation record set in 2008.

The key solar thermal markets in EU are France, Germany, Austria, Italy, Portugal and Greece. However, they were severely put off course by the 2013 market slide. United Kingdom had also been affected, due to a delay in implementing the Renewable Heat Incentive (RHI) for private individuals. Fortunately, the UK managed to get the RHI to kick into play in 2014, so that it has effect in more sectors than before.

3. RESEARCH METHODOLOGY

The main objective of this paper was to analyze the usage of two renewable energy sources – wind power and solar thermal power in Member States of the European Union in order to conclude which countries might be most interested in ISO 50001 certification.

The first step was to gather data from EUROSTAT, Eurobserver and to analyze the information given in a paper by Pascelia et al., 2016. on renewable energies in the European Union. The result was the separation of EU countries into three groups. Members that belong to the same group show similar tendencies and behavior in the field of using renewable sources of energy. The next step was to gather data about the number of exiting ISO 50001 certificates in those countries.

3.1. Data Collection

The paper by Pasceila Mihaela and all from 2016 on renewable energies in the European Union and data gathered from EUROSTAT suggest that EU countries can be separated in three groups:

- 1st group: Sweden, Denmark, Romania, Estonia and Czech Republic. These countries have registered energy dependence rates less than 30%.

- 2nd group: Austria, Latvia, Finland, Slovenia, France, Germany, Croatia, Bulgaria, Greece, Poland, Slovakia, Hungary, Netherlands, United Kingdom. These countries have registered energy dependence rates between 30% and 70%.

- 3rd group: Portugal, Lithuania, Italy, Spain, Ireland, Belgium, Cyprus, Malta, Luxembourg. These countries have registered energy dependence rates higher than 70% (Pascelia et al., 2016).

Sweden and Denmark , from the first group are very successful in achieving their targets. Sweden has even managed to achieve a share of 52.6% of renewable energy in gross final energy consumption, while Denmark was very close to achieving its target of 30% by having 29.2% in 2014. Swedish share of renewable energy production is 50.97%, however 28.70% is imported. On the other hand, Denmark has a lower percentage of renewable energy production 25.9%, but they managed not only to import additional energy, but they export 3.4%.

Latvia and Austria are the countries from the second group that have come very close to fulfilling their targets. Latvia had 38% out of 40% and Austria 33.1% out of 34%. Austria has the dependence of 64% and Latvia of 56%.

Lithuania is a country from the third group that has managed to surpass its target of percentage of renewable energy in gross final energy consumption in 2014, by having 23.9% while the target was 23%. However, it is an exception from the rest of the group, since others have achieved 17%-20%. Regarding their dependence, Lithuania is 80% dependant, and the rest are more than 80% dependant.

4. RESULTS

The table below (Table 1) shows the cumulative capacity regarding wind power at the end of 2013 (MW), the corresponding capacities regarding solar thermal power (MWth) in 2013 and the number of ISO 50001 certificates in member countries of the European Union.

Table 1. "Cumulative capacity regarding wind power, solar thermal power and number of ISO 50001 certificates in Member countries of European Union"

Country	Cumulative capacity regarding wind power at the end of 2013 (MW)	Corresponding capacities regarding solar thermal power in 2013 (MWth)	Number of ISO 50001 certificates in 2013	Number of ISO 50001 certificates in 2014
Germany	34660	728.0	2477	3402
Italy	8 542	207.9	258	294
Poland	3 429	191.9	22	38
Spain	22964	162.8	196	310
France	8 202	159.9	86	270
Greece	1 809	147.7	16	25
Austria	1 684	126.4	67	109
Denmark	4 810	72.8	45	51
Czech Republic	270	55.7	16	32
Netherlands	2 713.2	42.1	21	24
Belgium	1 653	41.3	28	28
Portugal	4 731	40.1	11	12
UK	11 209	31.5	330	376
Ireland	1 896	19.4	64	56
Romania	2 459	16.8	60	56
Hungary	331	12.6	13	29
Croatia	254.3	12.2	6	10
Cyprus	146.7	12.0	*	*
Slovenia	2.3	6.3	14	16
Sweden	4 194	6.3	94	87
Slovakia	3.1	4.7	12	12
Luxembourg	60.6	4.3	3	1
Bulgaria	676.7	3.9	6	12
Finland	447	2.8	9	10
Latvia	67	1.9	2	4

Lithuania	279	1.3	*	*
Estonia	248	1.3	1	3
Malta	0	1.2	*	*

5. DISCUSION

Countries from the first group who stand out by the amount of renewable sources of energy usage are Sweden and Denmark.

Sweden can do this thanks to its good natural conditions. One of its most valuable characteristics is that 53% of land is covered by forests while the global average is only 30%. This allows the amount of 85% to be provided by this sector. The district heating and cooling became free of fossil fuels, thanks to the widespread of heat pumps and biomass. They have also set a goal to use machines and transportation equipment without any fossil fuels by 2030. Due to the incentives to support renewables (quota system, tax regulation mechanisms, subsidy schemes, tax exemptions) and to the requirement to purchase green electricity, the number of companies that are invested in renewable energy is growing.This is crucial because investors are exactly what this sector generally lacks.

Denmark has a well-developed renewable energy sector, although it is almost completely devoid of hydropower resources (Pascelia et al., 2016). The usage of biomass, solar power, hydropower, tidal power and bio fuels all contribute to the amount of electricity obtained from renewable sources. A number of households, 60% of them, are provided with heat buy the power received from mostly biomass and other renewables. The heat system is a result of long planning and the awareness of need to conserve energy. The Danish government has introduces a premium tariff and net-meeting, together with other initiatives to support renewable sources of energy such as loan guarantees and subsidies. These mostly refer to the encouragement to build wind power plants and install small-scale renewable energy systems. Tax exemptions and obligations to use renewable heating and cooling systems in new constructions have been made in order to support the hearing and cooling sector.

Germany, however has biggest capacities regarding both wind and solar thermal power. It is also the leader in the number of ISO 50001 certificates in both 2013 and 2014, having had 2477 certificates in 2013 and 3402 in 2014. Denmark and Sweden had a much smaller amount of certified organizations in this period, and Sweden even had a smaller number in 2014 compared to 2013. However, ever since 2011, its numbers had been going up and it can be assumed that the same would happen in the future.

6. CONCLUSION

This paper's main goal was to analyze the data regarding the usage of renewable energy sources in European Union Member Countries together with the data about the number of ISO 50001 certificates in them and see which ones have been most interested in certification so far as well as try and predict which will be interested in the future and if there is a connection between the level of usage of renewable and the number of certificates. Data was gathered from Eurostat, ISO survey, Euroobserver, the paper my Pascelia M. and all (2016) "Analysis of renewable energies in European Union" and other sources.The analysis shows that countries which belong the European Union can be separated into three groups, based on their energy dependence. Countries with the lowest dependence are Sweden, Denmark, Romania, Estonia and Czech Republic. Sweden and Denmark are most involved in making renewable sources of energy widely used and Germany has had most certified organization regarding ISO 50001.

It can be concluded that those countries with the highest usage of renewable sources of energy have been more interested in ISO 50001 certification than those with lower usage rate. Given the fact that the number of certificates grows each year in most of the countries, it can be assumed that those leading ones in renewable energy resources usage will be most interested in certification in the future.

REFERENCES

Eurobserver , *14th Reoprt: The State of Renewable Energy in Europe, edition 2014*

Eurostat. *Renewable energy dependence.* Retrieved 19.03.2016., from http://ec.europa.eu/eurostat/home?p_auth=6rjfpO1w&p_p_id=estatsearchportlet_WAR_estatsearchportlet&p_p_lifecycle=1&p_p_state=maximized&p_p_mode=view&_estatsearchportlet_WAR_estatsearchportlet_action=search&text=renewable+energy

Certification Europe. *ISO 50001 Energy Management Certification.* Retrieved 18.03.2016.,from http://certificationeurope.com/certification/iso-50001-energy-management-certification/

Hemami A. (2012), *Wind turbine technology* , *CENGAGE Learning,* United States of America

ISO 50001:2011,Energy management systems - Requirements with guidance for Use. International Organization for Standardization .

ISO 50001: 2011- Energy management. International Organization for Standardization. Retrieved21.04.2016., from http://www.iso.org/iso/home/standards/management-standards/iso50001.htm 22.04.2016.The State of Renewable Energy in Europe, edition 2014, 14th Eurobserver report. Retrieved 18.03.2016.,from http://www.eurobserv-er.org/14th-annual-overview-barometer/

ISO 50001- Energy management systems- A practical guide for SMEs. International Organization for Standardization. Retrieved 22.04.2016., from http://www.iso.org/iso/home/store/publication_item.htm?pid=PUB100360

ISO Survey 2014.International Organization for Standardization. Retrieved 22.04.2016., from http://www.iso.org/iso/home/standards/certification/iso-survey.htm?certificate=ISO%209001&countrycode=AF

National Geographic. *Wind Power.* Retrieved 21.04.2016.,from http://environment.nationalgeographic.com/environment/global-warming/wind-power-profile/

Office of Energy Efficiency & Renewable Energy. *How do turbines work?* Retrieved 22.04.2016., from http://energy.gov/eere/wind/how-do-wind-turbines-work 21.04.2016

Pasceila M. , Burcea S. & Colesca E. (2016). *Analysis of renewable energies in European Union. Renewable and Sustainable energy reviews, Volume 56, Issue April, pages 156-170,* doi:10.1016/j.rser.2015.10.152

Sorensen B. (2011) , *Renewable Energy- physics, engineering, environmental impacts, economics & planning*, Elsevier Academic Press, Denmark

U.S. Energy Information Administration. *Solar Explained, Solar Thermal Power Plants.* Retrieved 22.04.2016. ,from http://www.eia.gov/Energyexplained/?page=solar_thermal_power_plants

THE ROLE OF HIGHER EDUCATION IN BUILDING AND IMPROVING NATIONAL QUALITY INFRASTRUCTURE – THE CASE OF SERBIA

Jelena Ruso*[1], Jovan Filipović[1], Gordana Pejović[1]
[1]University of Belgrade, Faculty of organizational sciences
*Corresponding author, e-mail: jelena.ruso@fon.rs

Abstract: *The paper investigates presence of quality infrastructure elements within higher education curriculum. The target institutions are public universities in Serbia as an important part of quality infrastructure institutions. The data were collected from the official web sites of faculties in Serbia, using syllabuses of optional and compulsory subjects. The analysis is performed to classify the faculties into three categories depending on usage term related to quality infrastructure. The results show that nowadays quality and standards are widely recognized as interesting and popular topic of study but usually offered through optional subject within certain departments of faculties. Results of our study showed that only four faculties within University of Belgrade offer more than five QI subjects, and only one is from University of Novi Sad (Category I). Four faculties from Universtiy of Belgrade belong to Category II and only one from University of Kragujevac. Finally, four facultis of University of Belgrade are categorized within Category III.*

Keywords*: higher education, quality infrastructure, standards, syllabus, Serbia*

1. INTRODUCTION

The growing educational opportunities and needs for development of education are creating a changing environment for higher education systems throughout the world. Most countries have developed an entire industry of service providers that specialize in the diffusion of quality and standards through the provision of quality assessments, technical assistance, information, and training services. Higher education institutions are one of the public institutions that are important link in developing of national quality infrastructure (from now on referred to as: NQI). Nowadays, a functioning quality infrastructure (hereinafter referred to as: QI) is a prerequisite for access to regional and global education market and a key determinant of competitive advantage. In our research we will only focus on program and syllabus of public faculties in Serbia. Aim of this paper is to provide basic insight in current situation about involvement of QI elements in higher education in Serbia. For that reason, we analyzed contents of compulsory and optional subjects using official web pages of faculties. The results show that nowadays quality and standards are widely recognized as interesting and popular topic of study but usually offered through optional subject within certain departments of faculties. Only Faculty of organizational sciences, University of Belgrade – Department of quality management and standardization develops and offers the largest number of mandatory subjects focused on quality, standards, accreditation, metrology and conformity assessment as basic part of QI.

The reason for the investigation is popularization of the topic (QI and its elements) as well as accentuation of importance of educated experts (in the quality management and standardization field), who make decisions and policies at all macro, micro and meso levels. If the quality of education is not treated the right way, consequently, it will decrease the quality in the whole country.

2. NATIONAL QUALITY INFRASTRUCTURE

“Quality Infrastructure is the totality of the institutional framework (public or private) required to establish and implement standardization, metrology (scientific, industrial and legal), accreditation and conformity assessment services (inspection, testing and product, system certification) necessary to provide acceptable evidence that products and services meet defined requirements, be it demanded by regulatory authorities (technical regulation) or the market place (contractually or inferred)” (Kellermann, 2011). „These activities provide a vital link to global trade, market access and export competitiveness as they contribute to consumer confidence in product safety, quality, health and the environment” (Pejović, Filipović, Tasić, 2011).

Also, QI is important for the international recognition of product and service and its further competitiveness. Correspondingly, national quality infrastructure is significant for export. Therefore, we can say that establishing the good quality infrastructure is a step towards good governance which creates a favorable trade climate in region. “Good governance is understood as good political framework conditions, rule of law and a responsible handling of political power and public resources by the state and thus an important

precondition for poverty alleviation and ensuring sustainable development“(PTB, 2007). What is necessary is that all these QI elements are connected through QI institutions and communicate with regional and international institutions, making the invisible global network (Figure 1).

In the QI system, accreditation plays a very vital role. “It is a formal confirmation that a body is competent enough to perform certain tasks” (Shaukat, 2010). It builds confidence in the work of testing laboratories, certification and inspection bodies, and facilitates mutual recognition of certificates, in addition to promotion of trade (Ibid.). No less important QI elements are „metrology“, which guarantees accurate and reliable measurements (See Wehmer and Frota, 2012), and “standard“, as a tool in free trade and in conformity assessment. International Standard ISO/IEC 17000:2008 defines conformity assessment as a “demonstration that specified requirements relating to a product, process, system, person or body are fulfilled.” What is necessary is that all these QI elements are connected through QI institutions and communicate with regional and international institutions, making the invisible global network.

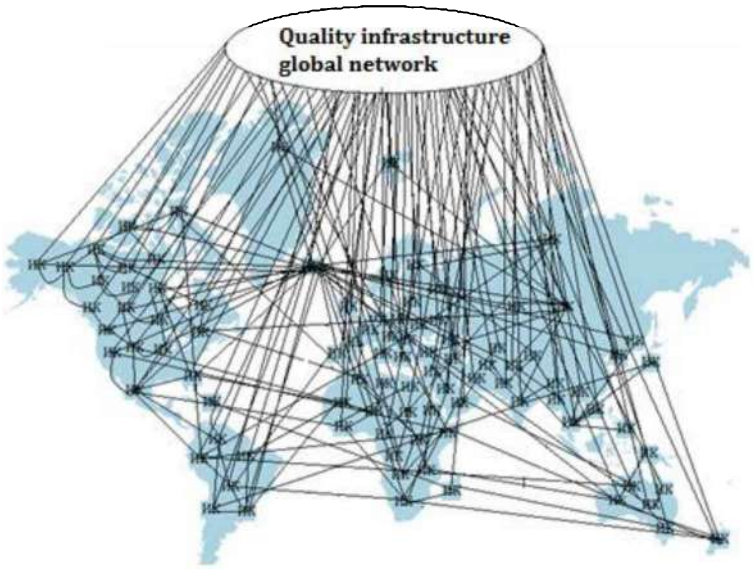


Figure1. Quality infrastructure global network (Inspired by Wheatley и Frieze, 2006)

3. KNOWLEDGE AND POLICY MAKERS

The article "*How to strengthen the Serbian politicians*", published in 2013 on the web page "Policy Online", said that "our political elites are semi-educated, regardless of formal education, without experience and morals. Only few people in politics are from practical sphere and they do not confer with science. In accordance with Hulnick (1986), “policy makers are government officials who formulate, choose, and implement policy”. In the decision making process, policy makers’ education and professional experience is likely to be important because they are more likely to distinguish good from bad advice and might be more able to resist the pressure of lobbying groups preferring the status quo. Dreher et al., (2009) had tested whether the educational and professional background of heads of governments influences the implementation of reforms and their results showed that “reforms are significantly more likely when the politician has an entrepreneurial or scientific background” and vice versa. They claimed, entrepreneurs are strong leaders and have a proven record of experience in leading a company and they have basic knowledge of the issue while trained and educated policy makers are more rational and less emotional in taking economic decisions.

The research was limited just to heads of governments in economic field. They did not consider other policy makers and other policy fields. Similarly, Jones and Olken (2004) find a positive relation between the education of leaders and the rate of growth and Besley et al. (2011) find that more educated politicians generate higher growth. Mikosch and Somogyi (2008) quoted by Dreher et al. (2009), find that political leaders with education in economics generate significantly lower budget deficits than those with education in law. Accordingly, we can say that “more educated politicians are better” (World Bank, 2005) in decision making. Therefore, if we want to develop national prosperity, we need educated and competent decision/policy makers with a lot of experience. The correlation of education background and other characteristics of decision makers could be interesting for this topic. Actually, how much “knowledge base” allows them to locate that knowledge in a broader social and political context.

All this indicate that education in the field of quality infrastructure is very important, because if there are no institutions that educate people in this area, many wrong decisions could be made. So, in the next chapter we are going to position faculties as a part of QI network.

4. HIGHER EDUCATION IN SERBIA RELATED TO QUALITY INFRASTRUCTURE

Higher education institutions are one of the public institutions that are important link in developing of national quality infrastructure (See Ruso et al., 2015). The modern University faces the challenge of adjusting to a complex world with new demands for professions and skills associated with the knowledge society. To successfully meet these important challenges, it is fundamental that universities' governing bodies have good relation with the academic community in order to respond to the social and productive needs of its environment (Espinoza and González, 2013). If the policy is embraced by institutions that have the ability to influence decisions and actions, such institutions can be called policy makers.

In Figure 2 we mapped the QI institutions and relationships among them. The basic institutions in the QI network are Directorate of measures and precious metals, Accreditation body, Institute for Standardization, Ministry of Economy (QI department) and conformity assessment bodies. Partly involved institutions in the QI network by certain departments are Ministry of trade, tourism and telecommunications, Ministry of finance, Ministry of agriculture and environmental protection, Ministry of education, sciences and technological development, the Chamber of commerce and industry and faculties. Faculties educate people in the QI field that are employed in other relevant institutions in Figure 2. Other connection between faculties and QI institutions are QI experts which are involved in teaching as visiting lecturers. Also, institutions' cooperation allows students to do internship and volunteer in quality management and standardization sector.

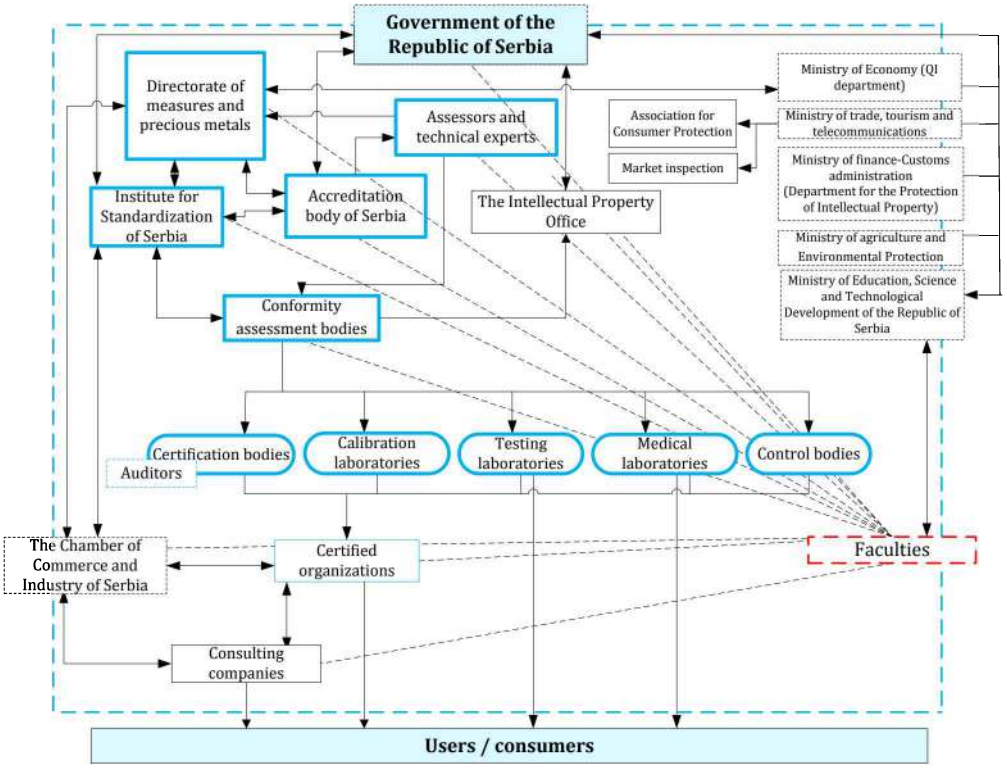


Figure 2. Quality infrastructure institutions (Source: personal)

People who have knowledge about IQ and its elements are more competent to plan, control, improve and assure quality at all levels take initiatives and make decisions related to it. Therefore, quality infrastructure and its elements should be recognized as essential topic of study in Serbia. With the aim to investigate the current state, we carried out research to display if Serbian higher education system recognizes IQ as important and essential part of quality life.

4.1 Methodology

4.1.1 Data Collection

The data were collected from the official web sites of faculties in Serbia, using syllabuses of optional and compulsory subjects. Key search words were: quality, standard/standardization, accreditation, metrology (for Category I), control, measure, production, technology, management, business, environment (for Category II) and marketing, sales, trade, market, transport, and trade laws (for Category III). The total number of faculties, used in this analysis was 19 (University of Belgrade, University of Novi Sad, University of Kragujevac and University of Niš).

4.1.2. Data Analysis

An analysis was performed to classify the faculties into three categories depending on usage term related to quality infrastructure. In Category I we grouped faculties which directly study subjects such as metrology, standardization, quality and accreditation. In Category II, we grouped faculties whose subjects are important for the issue. This kind of subjects could partly shape knowledge about QI, and people who pass it could possess enough knowledge to understand and manage problems related to QI. The last but not the least, in Category III we grouped faculties which are somewhat important as input in decision making processes. They can give some basic knowledge for understanding the problem, but not enough for making main decisions and quality control.

4.2 Results

The results show that faculties which directly target quality infrastructure elements (Category I) are Faculty of organizational sciences - FOS (Quality Management and Standardization Department) - University of Belgrade, Faculty of Technology and Metallurgy, University of Belgrade (Chemical Engineering Department - Quality Control), Faculty of Sciences, University of Novi Sad (Chemistry, Biochemistry and Environmental Protection Department - Quality control and environmental management) and Faculty of Agriculture, University of Belgrade (Food Technology Department – Safety and quality control in food production). Particularly subjects are: standardization, metrology, accredited laboratories, quality control, quality planning, quality costs, fundamentals of quality, quality system, quality control of industrial products, quality assurance system in production, quality control of environment, quality inspection and environment control, quality standards, statistical quality control, techniques for quality improving, normative regulation of quality, quality control in agribusiness etc.

Faculties which offer quality infrastructure subjects related to IQ elements, could help in better understanding of the topic and they are classified into Category II: Faculty of organizational science, Faculty of Agriculture, Faculty of mechanical engineering, Technical Faculty in Bor (University of Belgrade) and Faculty of engineering (University of Kragujevac). The list of subjects includes: production systems, management of key production performance, cost control, risk control, sales management, packaging and food packaging, the management of the food industry, business management system, production management, process management, merchandising, measurement and control processes in the metallurgical industry, protection management systems etc.

Finally, the third category of faculties includes Faculty of Transport and Traffic Engineering, Faculty of Economics, Faculty of Law and Faculty of Pharmacy. These faculties offer the subjects related to some of the QI elements at the introductory level. For example: transport of goods, fundamentals of logistics, supply chains, economic relations of Serbia with foreign countries, trade marketing and sales management, international business and management, foreign trade operations, International commercial Law, Trade Law etc.

5. CONCLUSION

Aim of this paper is to provide basic insight in higher education curriculum and investigate how the curriculum, including subjects (optional and compulsory), is connected to QI elements. In syllabuses, we analyzed the presence of usage of the term standards, quality, accreditation, certification and other (control, measurement, production, service, risk etc.) by the official faculty web sites. We categorized faculties in three groups depending on the number of subjects, directly linked to QI. Results of our study showed that only four faculties within University of Belgrade offer more than five QI subjects, and only one is from University of

Novi Sad. Specific subjects belong to Category II, where the subjects indirectly target QI elements such as FOS, Faculty of Agriculture, Technical Faculty in Bor, Faculty of mechanical engineering and Faculty of engineering, University of Kragujevac (more than 10 subjects). Ultimately, the third group includes the subjects at the introductory level refers to market, marketing, trade, trade laws, supply chains, logistics etc. The faculties which take place in the Category III are Faculty of Transport and Traffic Engineering, Faculty of Economics, Faculty of Law and Faculty of Pharmacy. In summary, our results suggest the least number of subjects belong to Category I and Category III. The subjects in Category II are most numerous. Only Faculty of Organizational Sciences develops certain department with the biggest number of mandatory subjects directly connected to quality infrastructure.

However, our results have certain limitation due to availability of syllabuses. For example, University of Novi Pazar does not have all "book of subjects" available on the web site. Also, the investigation does not include master, PhD studies and private faculties, therefore the limitations are suggested as an area for future research. We need to keep in mind that the results are not so strict, because they give just basic insight in current situation in Serbia. Likewise, there is the possibility of carrying out research among the Balkans and compare it with Serbian higher education program related to IQ elements such as quality, standardization, certification, accreditation and conformity assessment. Also, the students of quality management and standardization department could be interviewed and asked for their opinion and satisfaction about subjects in comparison with market needs for experts in the field of quality management and standardization. Also, the experts in the QI field could give their opinion about the education system (QI departments) and it could be compared with the students' opinions.

The results could help scholars, policy-makers, decision makers and the Government to understand how the quality and standards are perceived and considered in higher education in Serbia.

REFERENCES

Besley, T., Montalvo, J. G., & Reynal-Querol, M. (2011). Do Educated Leaders Matter?*. *The Economic Journal*, *121*(554), F205-227.

Dreher, A., Lamla, M. J., Lein, S. M., and Somogyi, F. (2009). The impact of political leaders' profession and education on reforms. *Journal of Comparative Economics*, *37*(1), 169-193.

Espinoza, Ó., Eduardo González, L. (2013). Accreditation in higher education in Chile: results and consequences. *Quality Assurance in Education*, *21*(1), 20-38.

Hulnick, A. S. (1986). The intelligence producer–policy consumer linkage: A theoretical approach. *Intelligence and National Security*, *1*(2), 212-233.

ISO/IEC 17000:2008, Conformity assessment -- Vocabulary and general principles

Jones, B. F., & Olken, B. A. (2004). Do leaders matter? National leadership and growth since World War II. *National Leadership and Growth Since World War II (March 2004)*.

Kellermann M., (2011). Thoughts on a National Quality Policy, Physikalisch Technische Bundesanstalt

Pejović, G., Filipović, J., & Tasić, L. (2011). How to remove barriers to medicines trade in emerging economies: the role of medicines regulatory authority in Serbia. *Accreditation and Quality Assurance*, *16*(4-5), 253-261.

Physikalisch Technische Bundesanstalt (PTB, 2007). Values and rules for global responsibility Quality infrastructure: a step towards Good Governance, Germany

Politika (2016), *Kako se kale srpski politicari.* Accesed on April 1, 2016, at http://www.politika.rs/rubrike/Politika/Kako-se-kale-srpski-politicari.lt.html

Ruso, J., Horvat, A., Djuric, M., & Trajkovic, A. (2015). Quality infrastructure in higher education–The case of Serbia, The 2015 International Conference on Education and Modern Educational Technologies (EMET), pp 135-139, July 16-20, Zakynthos Island, Greece, ISSN: 2227-4618, ISBN: 978-1-61804-322-1.

Shaukat H., (2010). Industrial competitiveness through quality infrastructure, Pacistan national accreditation counsil http://www.pnac.org.pk/index.php?PageId=133

Wehmer C.M, Frota M. N., (2012). The role of metrology - related functions for the free movement of goods, XX IMEKO World Congress Metrology for Green Growth 14, Busan, Republic of Korea

Wheatley, Margaret J., Frieze, Deborah (2006). Lifecycle of Emergence: Using Emergence to Take Social Innovations to Scale, Berkana Institute, http://www.berkana.org/articles/lifecycle.htm, (accessed October 09, 2011).

World Bank, (2005). The political economy of Gram Panchayats in South India: Results and policy conclusions from a research project, Edward Elgar Publishing Limited, UK.

THE ROLE AND THE PERCEPTION OF THE STANDARD ISO 22000

Luka Jovanović[1], Milica Ilić*[2], Mladen Đurić[2]
[1]Company ChipsWay
[2]University of Belgrade, Faculty of Organizational Sciences
*Corresponding author, e-mail: milica_littly@hotmail.com

Abstract: *The problem in this research study refers to the review of the standard ISO 22000 management system's role for food and safety, applied by a company which implements the requirements of this standard through its processes, managing risks for food safety, ensures a safe product which customers would recognize as a necessary quality for their needs. The topic of this letter is tied to the explanation of terms of the standard, brief explanation of standards, Global GAP, British Retail Consortium (BRC), International Food Standard (IFS), and particularly the system of Hazard Analysis and Critical Control Points (HACCP), representing an introduction to the explanation of the standard ISO 22000 and review of its structure. The significance of the above mentioned is shown by the results of the conducted survey, its ultimate target being to increase profitability in the food supply chain industry and ensure customer protection by improving food health safety.*

Keywords*: standards, quality, HACCP, ISO 22000, food safety*

1. INTRODUCTION

A business system that aims to achieve a profit, survive and secure development in the domestic and global markets, as an imperative must have quality, as the most important condition of success and longevity of each subject, and therefore cannot have an alternative. The mentioned quality of the product, understood from a customer's subjective viewpoint, can have multiple dimensions, and when discussing about food as a product, the most important aspect is indeed its usage safety. For this reason, the aim of this paper is to demonstrate the role of ISO 22000, which ensures the customer with a safe product and a feeling of satisfaction, by applying such standard demands of food safety from the customer.

Firstly, this paper will briefly explain the term standard, after which it will mention the international standards for food safety, Global G.A.P., the British Retail Consortium (CONNIE), the International Food Standard (IFS)and the system for Analysis of Hazards and Critical Control Points HACCP displaying their connection with the standard ISO 22000 primarily through a common goal – which is to increase food security, from the consumers' point of view as well as market operators who apply them.

In terms of what was said at the beginning, about the subjective way of looking at quality, the final section of this paper will focus on user perception, where the terms quality and food safety will be explained for which we can consider to represent the two key terms of this standard. Survey seeks to answer the user's position on certain aspects related ISO 22000.

2. STANDARD

A standard is a document established by consensus and approved by a recognized body, which shall set out for the general and reusable rules, policies, characteristics of activities or their results, in order to achieve an optimal level of quality in a given context. Standards should be based on validated results of science, technology (techniques) and experience, in order to achieve optimal benefits for the society (Zakon o standardizaciji, 2005). Therefore, the standards are accepted and defined norms that define specific properties and characteristics of products, methods and ways of their production, testing and evaluation of conformity with the requirements of the product.

3. INTERNATIONAL STANDARDS FOR FOOD SAFETY

The current situation on the market implies rapid changes to the selling methods of food that will increasingly lead consumers to supermarkets. Supermarkets will demand, through certification and different standards, for all products to have clear and distinct traceability.

Global G.A.P. is a standard that includes the production of primary agricultural products and activities after the harvest. This standard is intended to provide assurance about the retail and consumers, as well as to show that all the necessary measures and controls to make the product safe for consumers' health were taken. The principles of these standards are (R. Mijatović & M. Mirčevski, 2011):

- manufacturing of high-quality products;
- environment protection;
- the optimal use of natural energy resources;
- support of economically acceptable agricultural production;
- combining the best available profitable practice;
- improvement of local communities' living conditions.

The British Retail Consortium (CONNIE) was created because of the need for certification bodies that inspect food vendors in accordance with a unique set of requirements and, thus, avoid duplication and extra work when they check it. CONNIE allows food distributors to focus on market and in doing so, doesn't have to think about food safety. The standard was developed to assist retailers in fulfilling statutory obligations andprotection of clients, or consumers, as a basis for the evaluation of companies delivering branded food products. Also, the standard gives suppliers an opportunity to meet the criteria of different retailers with a single certificate, which on the one hand reduces costs, and on the other , these same traders reduce the costs related to suppliers' control.

International Food Standard (IFS) is a standard developed to verify the competence of food producers in terms of security, but also the quality of the food with the help of a single standard, thus saving time and money. The IFS is the standard of quality and standard for food safety all in one. Those highest standards of food are based on the principle of traceability i.e. the possibility to, at any time on the way from the primary producer to the end user, escort the correctness and quality of the product at each stage of production and distribution. The standard applies to suppliers at all levels of the food processing, except for agricultural production.

3.1. HACCP (Hazard Analysis Critical Control Points)

HACCP Definitions

The HACCP system involves a series of procedures to control processes and sensitive points in the chain of food production with the ultimate goal of consumer's food items used in a state and in a way that is safe for his/her health. The World Health Organization has adopted it as the most effective means to control diseases caused by food (R. Mijatović & M. Mirčevski, 2011).
HACCP is currently defined through five preliminary steps (from 1992) and seven principles. HACCP is not testing end products in order to guarantee food safety. Instead, it incorporates food safety in the production process and relies on the process of control to prevent or reduce existence of known risks to acceptable level of in food product.
Key aspects and objectives of Codex HACCP are (R. Mijatović & M. Mirčevski, 2011) :

- measurement and control;
- critical control stage;
- risk analysis;
- preventive actions;
- corrective actions;
- planning;
- HACCP (control) system;
- the HACCP team;
- surveillance and monitoring;
- seriousness
- V&V (verification and validity).

The main goal of the HACCP plan is to identify potential hazards, evaluate what points in a manufacturing process lead to a high risk for food safety, and in which it is possible to control such danger.

Benefits of HACCP

As one of the first food safety management system that is widely accepted in food processing operations, its gains obtained from the establishment of an effective HACCP system are multiple. For operators who operate with food, these include producing safer foods and lower business risks, improving and maintaining your reputation, better organization and staff time utilization. From the consumers' point of view, they include reducing the risk of food-borne disease and greater confidence in food safety. For the country's government, the gains include rational control food safety, reducing the cost of healthcare and facilitating international trade in food.

4. FOOD SAFETY MANAGEMENT SYSTEM ISO 22000

Food comes to consumers through a supply chain, which can link different types of organization and that can be spread through multiple borders. One weak link can mean unsafe food that is hazardous to your health. When this happens, the risk for consumers can end up being very dangerous, and expenses for a chain of suppliers of food very high. How a risk to food safety can occur at any point in the chain, it is very important to have adequate control on every step of the way. Food safety is the responsibility of all participants in the production and distribution of food and requires common efforts by one goal (M.M. Markuš, 2006).
The growing demand for food safety by pressuring manufacturers and distributors to develop food safety management system based on HACCP led to the ISO to take measures for the development of appropriate standards in 2001. The first intention was to rise above the usual requirements for food safety.
The goal was harmonization of national and private standards and inclusion of the management system of ISO 9001.

4.1. The Scope of Application

The standard ISO 22000 refers to a food safety management system. A subject to the application of ISO 22000 is managing risks to food safety in order to ensure a safe product and hence enhance the satisfaction of end-users. The work is focused on controlling measures that should apply to ensure the harmonization process with the client requirements and regulations concerning health food safety.
The standard is intended for communication between business partners (B2B) and is not intended for communication with end consumers, and thus set the logo on the product is not allowed.
ISO 22000 is designed to enable for all organizational types in the movement of food to implement food safety management system, its requirements apply to all types of organization in the food chain: food producers, primary producers, food processors, transportation and storage, along with mutually related organizations such as producers of equipment, packaging material, cleaning agents, additives and food ingredients. That is, for all organizations, regardless of size, that are involved in any aspects of the food chain and that want to implement a system that would constantly produce products safe for health (Z. Abdirahman & L. Sauvee, 2012).

4.2. Structure Standards

ISO 22000:2005 is a proprietary standard, established by the International Organization for Standardization (International Organization for Standardization-ISO). It uses the methods of management of health food safety through specifying requirements that combine key elements to ensure food safety throughout the food chain to the point of final use. The before mentioned requirements encompass (N. Živković, 2012):

1. **The management system** of the ISO 9001-as 22000 standard gives requirements to management responsibility, measurable objectives and expected impact as a basis for quality management system, contributing to constant improvements through continuous monitoring, through corrective and preventive measures.
2. **Communication in the food chain** – as already mentioned in the course of this paper, the danger for the security of food can occur at any stage of the food chain so accordingly it requires an efficient control and elimination, or reduction of error possibility. The purpose of ISO 22000 is to require from all participants in the food chain to communicate and provide effective flow of information.
3. **Previously necessary programs (PRP)** are the basic conditions and activities that are necessary throughout the whole food chain for maintaining hygienical environment that is suitable for the production, handling and supplying safe final products and safe food for human consumption (J. Babić, 2014). Previously required programs are aimed at the protection of products from contamination caused by biological, chemical and physical food safety risks, the control of bacterial growth that can be a consequence of temperature disturbances and maintenance equipment. PRP is practically representing those activities that do not belong to specific HACCP plans, what would later be covered, that affect health food safety.

4. **HACCP Plan**

Training and formation of teams for HACCP-The staff operator that operates food needs first to finish training for HACCP, which is adapted to their responsibilities in the HACCP plan. For anyone who is into direct or indirect contact with food, the HACCP plan should be clearly shown and explained, and procedures that this feature must be adhered to.
The HACCP team typically makes more people because for the development of HACCP system is necessary to rule a broad spectrum of knowledge and experience. The team shall possess all the necessary specific

knowledge about the products and processes, in combination with the general knowledge in the field of systems of quality management and food hygiene (United States Department of Agriculture, 1999).

Description of the product and a description of the intended use-the HACCP team must be provided the complete insight into all of the products that the HACCP plan applies to. The description of the products is a necessity to be composed for each product separately.
Also, it is important to identify the potential users of the products and, if relevant, especially look at the use of the products by the sensitive group in the population (infants/children and youth, old, pregnant women, sick).

Manufacturing process flow diagram – the flowchart process needs to be designed by the HACCP team and to cover all steps in the production of what is it in reality. For each production operation there are steps that precede and follow the specific operation and production process present in the HACCP plan. The
HACCP team needs to verify the accuracy of the (verified) flowchart process carefully by comparing them with actual activities along the whole line of production ("on the spot"), during all stages of actual work. Then, if necessary, it needs to improve or add value to it (United States Department of Agriculture, 1999). Similarly, comparing constructed diagrams and actual activities on a production line, the competent authority shall verify later that the flowchart is true and complete.
Each step in the manufacturing process necessarily has to be described in form of standard work procedures/operations (SOP).

Principle 1 – Risk Analysis

Risk analysis involves listing all potential hazards for which there is a realistic expectation that will affect every process in the area of primary production, processing, and distribution to consumption that can threaten the health of consumers and includes two main elements:

1. Identification of danger - the HACCP team needs to identify and accurately specify all dangers for which reasonably expects that could be associated with the product as a result of direct or indirect contamination on any point of the production process. By their nature, hazards can be biological, chemical and physical.

2. Categorization and ranking the risk of specific hazards - For each risk it is necessary to perform risk assessment. The main goal is to create a clear picture of which of the identified hazards is the most important problem for the safety of the products. Depending on the results, the main efforts and resources should be focused on the successful prevention of the the most important problems, because they represent the highest risks for the safety of the product.

After that, the HACCP team needs to consider what control measures are available to eliminate or at least reduce the risk in the product, as well as whether, how and on what process step those measures can be applied.

Principle 2 – Determine the critical control points

Process step where a risk is unacceptably high risk is considered critical for the safety of the product and is called the critical point. At this point, the risk must be eliminated or significantly reduced by applying specific control measures; named critical control point (CCP). In order to identify critical control points, use the decision tree for the CCP (D.A. Corlett Jr., 1998).

Principle 3 – Establish critical limits for each CCP

A critical limit is the criterion that separates the acceptable from the unacceptable. In other words, a critical limit defines the parameters of the process which must not be exceeded (H.Hughes, 2008). When this value is exceeded, is considered that CCP is no longer controlled and corrective action must be taken (J.G. Surak & S. Wilson, 2014). These limits must be based on scientific, measurable, and validated knowledge.

Principle 4: Establishing monitoring procedures

Definition of monitoring Codex Alimentarius reads as follows: "the implementation of a planned sequence of observations and measurements to assess whether a CCP is under control and security/keeping accurate records for use in future verification." (D.A. Corlett Jr., 1998)

Principle 5: Determine corrective measures

Specific corrective measures must be developed for each CCP in HACCP system, which resolves the errors and deviations of the process if/when they arise. Corrective measures must ensure that the CCP is brought under control(H.Hughes, 2008); to prevent potentially noxious food reaches consumers and preventing it happening again.

Principle 6: Establish procedures for verification

The HACCP system must be adequately and regularly checked to ensure its effectiveness and coherence between what is meant or planned and what is really going on regarding food safety in a given subject.

The HACCP plan validation is performed before implementation of the HACCP system, and is a confirmation of sucesfuly developed all elements of the HACCP system. That is, it means that the HACCP plan, once applied, control food safety adequately.

Verification of the HACCP plan is a confirmation, after its implementation, the plan is effectively implemented and that is effective – that the danger for the security of food is under control.

Principle 7: Establish procedures for documentation and records

A successful and orderly maintenance of documentation is essential in the application of the HACCP system. All activities undertaken in the system of HACCP must be planned, documented, and they must take the records as proof that they were executed (Lj. Jovanović, M. Pavlović, D. Panković, N. Penezić, V. Radović, M. Pucarević, G. Dugalić, N. Bokan & M. Petrović, 2014).

A review of the standard structure

In the structure, similar to ISO 9001, in addition to the foreword and introduction, ISO 22000 contains eight parts: the first three are global, while the following five are related to the requirements of the management system.

Point 4 of the standard: food safety System-This point is stressing the health food safety management system requires establishing, documenting, implementing and maintaining an effective ISO 22000. This includes procedures and required records to ensure the effective development, implementation and updating of ISO 22000.

Point 5 standards: leadership Accountability-Accountability of leadership for this standard is covered through eight detailed requirements related to: dedication, the establishment of a food safety policy, for planning activities, responsablity and influences,naming the team leader for safety, ensuring effective communication processes, review of management (M. Bugdol & P. Jedynak, 2015).

Point 6 of standard: Management resources-Effectively applied FSMS requires the top level management to provide adequate resources, budget and staff to the system so it works effectively.

Point 7 of standard: Planning and delivering safe products – the ISO 22000 standard requires the Organization to plan and develop the processes needed for the realization of safe products. The organization will establish, implement and ensure the efficiency of the planned activities, as well as any changes in these activities, which are expected to include previously required programs, as well as the HACCP plan.

Point 8 of standard: Validation, verification and improvement of FSMS - to maintain and demonstrate the effectiveness of FSMS, organizations need to verify that all of the assumptions that were used in the system, scientifically based, or implemented are a validation rule. In addition, organizations need to plan, implement and document the regular verification of all system components, to assess whether, or not, modifications are necessary. Verification would also have to be a part of a continuous process of advancement, which is why organization verifies the system (I.S.Arvanitoyannis, 2009).

Organization needs to worry about constant improvement of effectiveness of product safety management system using policies, objectives, results, analysis of data, and corrective and preventive measures reviewed by management.

Advantages of application and the role of ISO 22000

The role of standard for a company is to, by applying it, achieve several advantages such as:

- better communication in food chains;
- enhanced document management;
- a better planning process;
- strengthen confidence in State agencies that control the quality of food (R. Mijatović, M. Mirčevski, 2011);
- lead continuous improvement process;
- reduction/control check by business partners;
- increase the safety of products, reduce cost and risks related to the return of products;
- greater efficiency and control food safety hazards;
- ensure the production of safe products;
- increase the confidence of users of the product.

5. USER PERCEPTIONS SURVEY

The behavior of consumers in relation to food security can be predicted if there is a systematic understanding of how consumers perceive the risks and benefits, in connection with various food safety issues, which will be attempted in a survey below.

The aim of this study is to examine the user's position on the importance of using safe products intended for human consumption, the procedure and the method of its use, its features bearing on the manufacturer of the product in case of submitting complaints, as well as their attitude about the need for the use of standards in the food industry and familiarity with standard ISO 22000.The survey covers 97 respondents, and largely consists of students of the Faculty of Technical Sciences in Cacak, while a smaller part is composed of employees of Chips Way Company.

The first two questions help in categorizing and analyzing results and relate to the gender and age of the respondents. Out of total number of respondents 70.1% are men, and 29.9% women. As for the age, 89.69% of the respondents are in the group between 19-26 years, 3.09% in a group between 27-35 years old, 4.12% in a group between 36-45 years, 2.06% in a group between 56-65 years, and 1.03% in over 65 years. The following questions in the questionnaire are designed according to the specific requirements of ISO 22000, which agrees to the stated objectives of the research. In this regard, the results and their graphical representation are presented below.

Question 3: Assess the level of security of food products that you buy?
The term refers to food safety, i.e. obligations of food companies to classify the products and the user's stance on this issue.

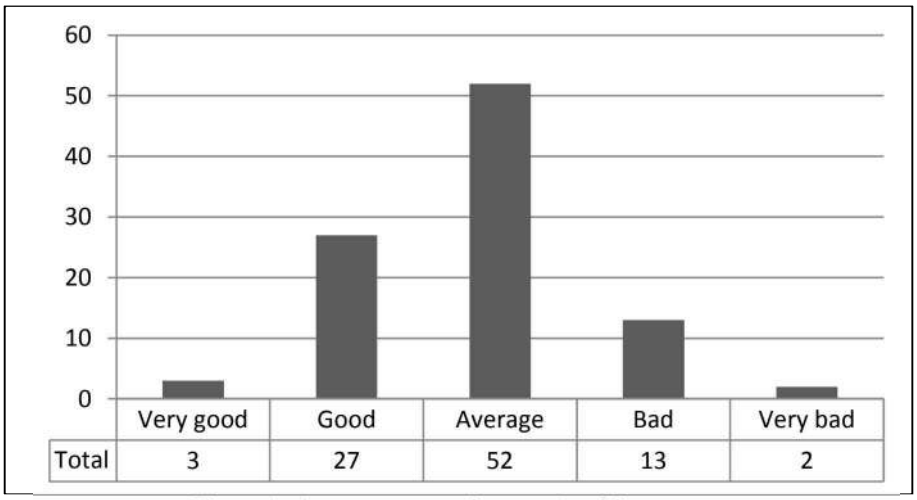


Figure 1 - Answers to question number 3 in a survey

The results show that 53.6% of the respondents considered that the food that they buy the average quality, where together with those respondents who responded with bad or very bad that percentage is even 69,07

percent. These data tell us that companies must make efforts to increase awareness by consumers and assure them that the products placed on the market are safe for consumption.

Question 4: Rate the level at which you think food companies are trying to eliminate all potential dangers in the production process of their products?
Refers to the requirements of point 4. ISO 22000-Risk Analysis.

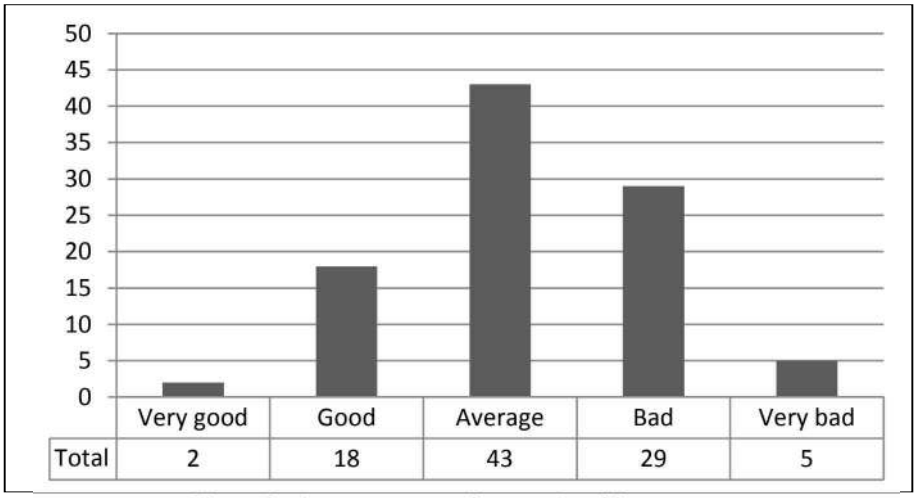


Figure 2 - Answers to question number 4 in a survey

The results show that the largest number of respondents considers the effort food companies are putting in eliminating potential dangers in the production process average and makes 44.33%. If we combine this group of subjects with those who gave as "Bad" or "Very bad" as their answer to the previous question, they make a percentage of 79,38%. Same with the previous question, companies engaged in food production, in case they want to change this attitude of respondents, should primarily change the picture of themselves and their actions in the food industry.

Question 5: Rate the importance of options of filing appeals on the safety of the purchased food products?
Refers to the requirements of point 5 of standard ISO 22000 – External communication.

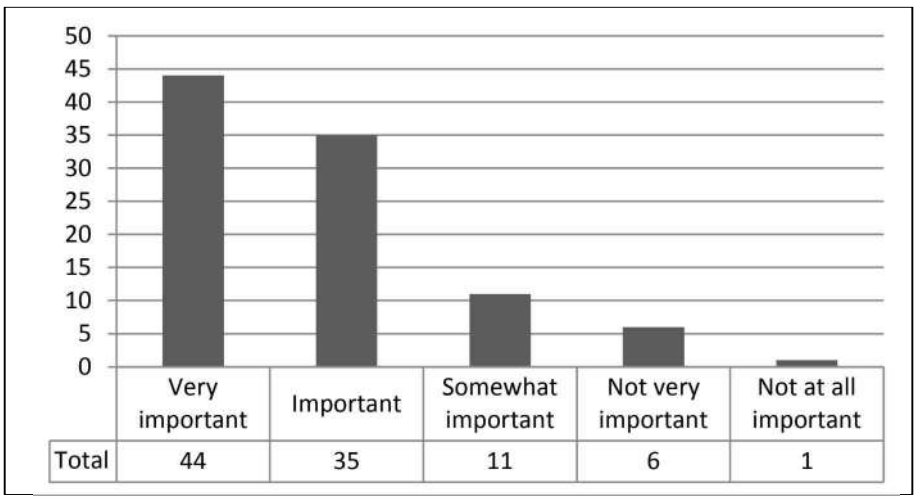


Figure 3 - Answers to question number 5 in a survey

As expected, the highest percentage of respondents makes for 45.37% and gives great importance to the possibility of submitting complaints to the observed failure of the purchased products. When we add this to the number of respondents who graded this question as "Important", that makes for 81,15%, which proves the importance of established procedures for appeal for users in every company that deals with the production of food products, and what the requirements of ISO 22000 are essentially about in the above mentioned point of standard.

Question 6: How well do you consider staff involved in the process of manufacturing food products is trained for tasks that affect food safety?
Refers to the 6. ISO 22000-Management resources, human resources.

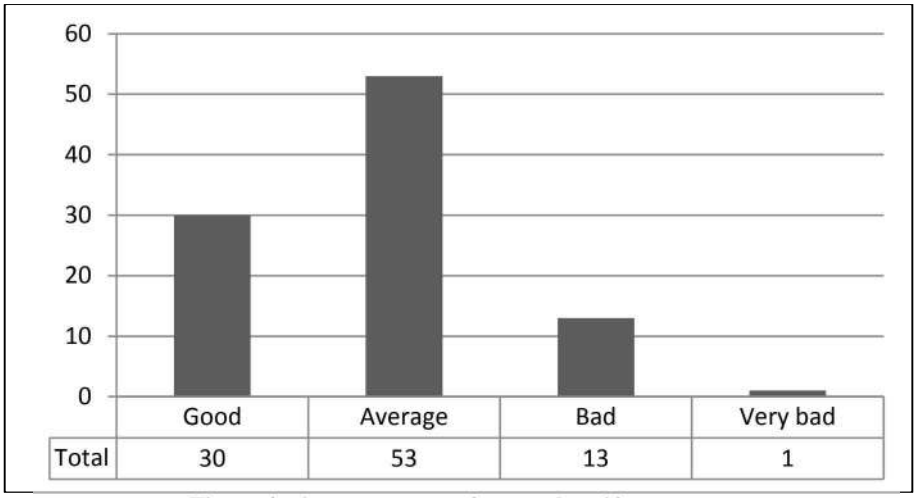


Figure 4 - Answers to question number 6 in a survey

The results of testing where none of the respondents did not answer the question as "Very good", returns us to the field of activity of companies in terms of increasing awareness of their activities and efforts to increase food security, and requiring users to recognize it. as what is shown, the answer that was given most frequently in this issue is "Average", which makes for 54.64% of the total.

Question 7: Rate the importance of hygiene in the production process/ storage process/distribution.
Refers to the previously required programs, i.e. good hygienic practice.

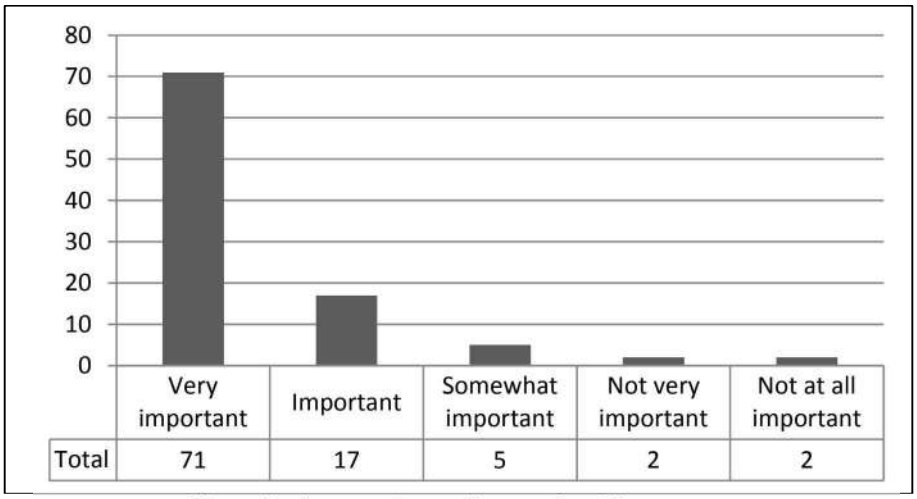


Figure 5 - Answers to question number 7 in a survey

The result of this issue is, as with the fifth one, completely expected. Primarily serves as a confirmation on user's general attitude about the importance of hygiene products in all processes of managing food. So, response to this question that is most often given is "Very important" and makes 73.20% ,and answer "Important" is given 17 times and makes 17,53%. If we add the percentages of the two responses up we get to 90.73% of respondents considers it very relevant for every company that approach the hygiene seriously in the sense that the end product is safe for consumers health.

Question 8: Are you familiar with standard ISO 22000 - food safety management system?

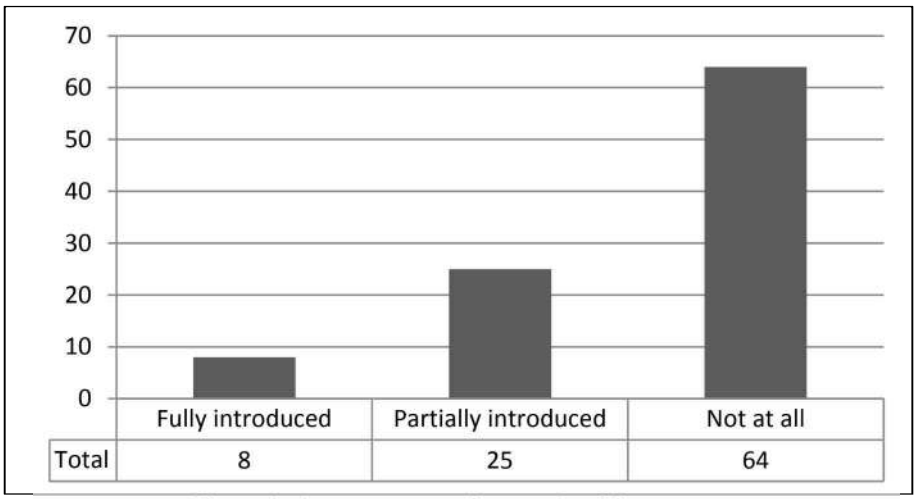


Figure 6 - Answers to question number 8 in a survey

The last question in the survey refers to the examination of those surveyed about knowledge of ISO 22000. The result of examination is such that 65.98% of respondents did not know about it, 25.78% is partially introduced, while only 8.25% is fully introduced with this standard.

6. CONCLUSION

The period of the last few years can be noted for how discussions relating to quality and food safety have become very common. The risks in ensuring food safety, as serious problems, are identified by international organizations, governments around the world, as well as our legislation and society as a whole. Parts of the public are becoming more interested and often critical in terms of raw materials, technology and hygiene of food production, both at the level of primary production and processing, and at the level of distribution/selling/serving.

ISO 22000 food safety is improving health and it provides consumer protection. In this way it strengthens the confidence of customers and increases the profitability in the food industry. It is used to accelerate and simplify the processes without compromising the other quality management systems or the health, safety and also, once implemented, this standard increases international acceptance of food products marketed on the market.
The results of implemented surveys unmistakably demonstrate the importance of requirements of ISO 22000 and the importance of the implementation of these requirements for every company that deals with the production and processing of food. Further on, these results also show that each company in addition to having efforts to meet the requirements of this standard, must make even greater efforts to that end that users become familiar with the level of the products' safety, aimed to be provided, because the end user, although considered relevant, is not familiar with the requirements of the company with an implemented standard ISO 22000 needs to meet. A solution to the problem can be found in implementing the channels of communication to the end-consumer and presenting work and effort in obtaining high-quality and safe products.
It should be emphasized that in today's business world, primarily in highly affluent markets where there is strong competition, but also the willingness of users to pay more for better quality, it is almost impossible to break in, for example in a chain supermarket, without the quality or safety of the product. Not only that consumers will not choose such a product, but it is also impossible to enter the market without them.

REFERENCES

D.A. Corlett Jr., (1998) *HACCP User's Manual*, An Aspen Publication, Gaithersburg, Maryland, USA

H.Hughes, (2008) *Hazard analysis and critical control point generic models for some traditional foods*, WHO, Cairo

I.S.Arvanitoyannis, (2009) *HACCP and ISO 22000 – Application to Foods of Animal Origin*, School of Agricultural Sciences, University of Thessaly, Greece

J. Babić, (2014) Sistem upravljanja bezbednošću hrane kao deo integrisanog sistema menadžmenta u organizacijama koje se bave proizvodnjom i prodajom hrane - *Marketing prehrambenih proizvoda*, Dosije studio, Beograd

J.G. Surak & S. Wilson, (2014) *The Certified HACCP Audition Handbook*, Third Edition – ASQ Food, Drug and Cosmetic Division, ASQ Quality Press. Milwaukee, Wisconsin

Lj. Jovanović, M. Pavlović, D. Panković, N. Penezić, V. Radović, M. Pucarević, G. Dugalić, N. Bokan & M. Petrović, (2014), *Proizvodnja i menadžment u organskoj poljoprivredi*, Univerzitet Educons, Sremska Kamenica,

M. Bugdol & P. Jedynak, (2015) *Integrated Management Systems*, Faculty of management and Social Communication, Jagiellonian University, Krakow, Poland

M.M. Markuš, (2006), *ISO 22000:2005 I HACCP*, 33. Nacionalna konferencija o kvalitetu, Kragujevac

N. Živković, (2012), *Integrisani sistemi menadžmenta*, FON, Univerzitet Beograd, Beograd

R. Mijatović & M. Mirčevski, (2011), Sistem menadžmenta bezbednosti hrane, Retrieved from: www.odbrana.mod.gov.rs

United States Department of Agriculture , Food Safety and Inspection Service, Washington , (1999, September), *Guidebook for the preparation of HACCP Plans*

Z. Abdirahman & L. Sauvee, (2012), The *Implementation of a Quality Management in a Food SME: A Network Learning Perspective, International Journal On Food System Dynamics*, Institut Polytehnique LaSalle Beauvais, France

Zakon o standardizaciji, (2005), SRPS ISO/IEC Uputstvo 2:2007

INNOVATIVE STRATEGIES FOR NEW COMPETENCE DEVELOPMENT – BRINGING THE REAL WORLD IN HIGHER EDUCATION

Ivana Mijatovic*[1], Vesna Damnjanovic[1]
[1]Faculty of Organizational Sciences, University of Belgrade
*Corresponding author, e-mail:ivanamt@fon.bg.ac.rs

Abstract: *This paper is aiming to raise issue of employees' competence development for future global business environment in quality management. The quality management professionals lately point some key trends which are transforming the future of quality: talent of people, creativity and innovation or knowledge and agility. The quality management profession needs "leadership talent worldwide" and the role of the quality managers are changing. The skills critical to the success at the work places are: teamwork/collaboration, creativity and innovation, critical thinking, problem solving, professionalism/work ethic, oral and written communications, information technology application, leadership and lifetime learning. The main challenge in higher educational institutions is how to prepare students for their future jobs and what type of learning method should be applied to match business environment needs. Creative active teaching includes using case study method in classroom and preparing talent students for case competitions. This innovative learning strategy integrates curriculum objectives with learning outcomes. Based on previous researches, case competitions have been shown to have multiple benefits for the students who are participating: developing managerial skills with focus on creativity and innovation, learning benefits and employability skills.*

Keywords*: quality management, higher education, case study competition, managerial competence*

1. INTRODUCTION

According to data of Word Bank Enterprise Survey, based on sample of 10,690 enterprises from 23 Eastern European countries, one of the most important obstacles for doing their business is inadequately educated workforce. It is particularly important to note that inadequately educated workforce is stated as obstacle after others obstacles: access to finance, corruption, political instability, practices of competitors in the informal sector and tax rates. According to same data source and based on data collected in 2012 in Serbia 37.5% of enterprise representatives reported inadequately educated workforce as obstacle to current operations.

Global and dynamic business environments influence the changes in the needs for organizational knowledge and competence. Social (global village), economic (global economy, worldwide sourcing and global offerings) and technological (technological progress as a base for globalization) changes influence practically every society and company. In many organizations obsolete knowledge, competence and skills are the main obstacles to development. Everett and Pege (2013) pointed that: "*At no time in the recent past have flexibility and creativity been needed more in rethinking and retooling the models of the relationship between universities and society…society wants value for its investment…But what is this socially sanctioned values? It includes at least that the average college graduate will be a more informed and better thinking citizen, better able to live a personally satisfying life because of their higher education experience – to be a prepared citizen. This in itself does not seem so different from past aspiration, except that now 'value' the idea that practical knowledge produced by higher education experience should be measureable in the short term and of sufficient magnitude…*".Based on OECD (2008) forward looking perspectives on higher education:

- The differentiation of the HEIs leads to an increasingly visible profile of institutions. What would be desirable is that different missions and visions (i.e. world-class research vs. catering for the needs of the national/regional labor market) are accepted as equally valid and worthwhile in terms of public support.
- The intensive networking among institutions, scholars, students and with other actors such as industry - more on collaboration than on competition. International collaborative research is also strengthened by the dense networking between and among institutions, driven by the availability of free and open knowledge.

In both cases the results related to research and/or quality of students are measureable which suggest that future of higher education will be highly competitive. The average first time employee with university diploma

should have practical knowledge, competences and skills of sufficient magnitude which can be used and evaluated by his/hers employer in the short term.
This paper is aiming to raise issue of employees" competence development for future global business environment in area of quality management. The paper is organized into five sections. The next section briefly introduces some new trends which are transforming the future of quality management. The third section deals with the need for crossing the lines between the corporate and academic world and the role of higher education in providing adequate future employees in such situational frame. The fourth section is presenting results of research studies related to case study method and case study competitions as creative and innovative tool for knowledge acquiring, developing of competence and skills needed in the business. Finally, the fifth section derives conclusion remarks.

2. THE QUALITY MANAGEMENT NEEDS TALENTS AND INNOVATIVE PEOPLE

The quality professionals lately point some relatively new words: *talent of people*, *creativity and innovation* or *knowledge and agility.* Many of the more or less new concepts in the quality management might be in connection with Draker"s claim: "management is doing things right; leadership is doing the right things" and need to better connect quality with "right things" in knowledge economy. According to the research report of Gutner and Adams (2008) key trends which are transforming the future of quality are: globalization, customer sophistication, talent management and leadership issues and environmental concerns and social responsibility. The authors elaborate that future "*leadership talent worldwide will likely be in short supply and a battle for the best and the brightest will continue*" and that critical aspect will be knowledge transfer within an organization. The role of the quality professional must become that of teacher and mentor, coach and player (Nash, 2014).

Study of Power (2014) showed that quality management in the plants in industrialized economies can be expected (on average) to be more competent (better in terms of "what we can do now") than those in emerging economies, however, the plants in emerging economy group are able to leverage investment in quality management programs to both promote greater competence in quality management, and to build capability for further improvement over time – which does not proved to be case in the group of the plants from industrialized economies. The data and results provided by Power (2014) can be read from different points of view – the industry organizations from developed countries might be faced with pressure to innovate and to connect their quality management learning initiatives and activities with results in the short term, while quality management in developing countries still can use existing knowledge to achieve improvements – not for a long time.

Not by the chance, new version of ISO 9001:2015 standard introduces new concepts in quality management system standards: concepts of risk and risk based thinking and its counterparts – opportunity, as well as concept of knowledge (Bureau Veritas, 2016). In the new version of ISO 9001, concept of knowledge as a resource and knowledge management have seen as a key to successful business development – requirements related to identification necessary knowledge, anticipation changes in knowledge needs as well as risk of failing to acquire needed. This was starting point for many management systems" training providers and consultants to start with courses related to the managerial competences and knowledge management - with the main idea that every organization within its context should deal with knowledge such as every other resource (in the meaning of PDCA).So, the quality managers are again in the trouble - if they do not have at least decent business management education.

The new edition of the EFQM excellence model integrates, for the first time the fundamental concepts such as: managing with agility, developing organizational capability, harnessing creativity and innovation and succeeding through the talent of peoplewith explanation that "excellent organizations value their people and create a culture of empowerment for the achievement of both organizational and personal goals." Knowing that the fundamental concepts of excellence have been identified through a rigorous process that included benchmarking globally, this is novelty in fundamental concepts can be explained by new needs of global business.

However, the roots of those new concepts can be found in quality management theory. According to Dahlgaard-Park (2011), "as the most widespread quality management approach during the last 25 years, the term TQM seems to have lost its attractiveness in Western parts of the world and instead new terms such as Business Excellence, Organizational Excellence, Six Sigma, and Lean seem to have overtaken the position even though the contents of these new terms can be understood within the framework of TQM". The study of Dahlgaard-Park et al. (2013) show that the total number of articles under the subject of TQM has been decreasing after having reached its peak in 1995, at the same time papers focusing on concepts within the quality management framework (e.g. Lean, Just in-Time, Toyota Way and Six-Sigma Quality) have been

increasing. Many reports about ineffectiveness of TQM were based on its highly complex concepts, many different forms – some authors of the TQM approaches define TQM as philosophy, some as dominant management practice. However, many TQM models, for example TQM models provided by Oukland, Besterfield or Dahlgaard, are underlined importance of management of organizational knowledge, competencies and skills. With implementation many quality initiatives and practices, it was difficult to link these initiatives within a single business framework and transferring ownership from Quality Department to the business as a whole (O'Brie and O'Hanlon, 2000, taken from Adebanjo). Problems of many quality management initiatives are related to insufficient capabilities of quality managers to cope with deploying activities, responsibilities and commitment to the issues. That might be one of the reasons for popularity of term business excellence.

According to the European Foundation for Quality Management (EFQM) - excellence is about doing your best. The EFQM Excellence Model, based on a cause and effects, provides a holistic framework for assessing how effective you are in developing and delivering a stakeholder focused strategy. The EFQM model was largely based on the concept of total quality management TQM and European Quality Award (EQA) was based on other TQM models such as Malcolm Baldrige National Quality Awards (Adebanjo, 2001). Regarding to effectiveness of EFQM models and based on present studies, still it is difficult to have hard positive or negative opinion. The EFQM models and many other authorized business excellence models (authored by individuals or other organizations) or customized versions are generic and effects are not only results of the model but of the quality of activities or solution conducted in order to obtain specific results. Integration in the processes of the organization in various ways can highly influence effective implementation of the EFQM Excellence Model (Davis, 2008). According to Gomez (2011), based on analysis of the relationships in the 2003 version of the EFQM model, leadership has a significant effect on policy and strategy, people and partnership and resources, however policy and strategy, people, or partnership and resources have no significant effect on operative results and processes. The study of Aryanaslet al. (2016) explored whether the EFQM Excellence Model mentioned model is suitable for the businesses that are based on cleaner production and sustainable business models - it was shown that despite adoptability of the fundamental concepts of EFQM Excellence Model, there were some lacking criteria for adapting them to sustainable business model.

The quality management development of competitive excellence emphasized a new role of recruiting the right talent as imperative for providing sustainable and profitable organization for long term.

3. CROSSING THE LINES BETWEEN THE CORPORATE AND ACADEMIC WORLD

In order to adopt higher educational needs to US market, Rochester Institute of Technology conducted research of key drivers of change in higher education today, including: technology (on line learning), globalization, changing demographics, changing students" expectations and understanding the Net Generation and changing employer needs (Casares et al, 2011). The rate of technology change and growth has been exponential and on line learning is growing. Millenniums generation expect flexible work hours, expect to be mobile and work from home, office and cafes. The most important millennial work values are: meaningful work and high salary (Meeker, 2015). Globalization influences higher education in multiple ways from a need to “internationalize” the curriculum and provide support services for non-native English speakers. International dimension is crucial for preparation of students for international careers developing educational program (European business) that fit the needs of students (Teichler, 1999). Another very important phenomenon to researchers relates to the impact of demographic changes, such as a large population growth in Asia, which represents an opportunity for business schools. On the other hand, characteristics of countries in the eastern part of Europe, such as very low birth rates, out-migration and rather high death rates, influence a decrease in the number of young population. That further implies a decrease in the number of potential students, and increased competition among business schools (Lutz,2011).

In the knowledge economy, employer needs for new entrant skills as critical to success in work: teamwork/collaboration, creativity and innovation, critical and thinking/problem solving, professionalism/work ethic, oral and written communications, information technology application, leadership, lifetime learning. The University of Glasgow (2011) investigated employers" perceptions of the employability skills of new graduates, and the steps which universities take to develop them. They used interviews method with 22 key informants from representative organizations for employers HEIs and other relevant groups (e.g. Association of Graduate Recruiters, Chambers of Commerce, Council for Industry and Higher Education etc) to explore issues pertinent to the research objectives and identify examples of good practice. Employers expect graduates to demonstrate a range of skills and attributes that include team working, communication, leadership, critical thinking, problem solving and often managerial abilities. Employers are frustrated that

higher education courses do not meet their needs. There is also a lack of systematic practice to promote employability across higher education institutions and schools do not see employability as an important part of their mission.

4. CASE COMPETITIONS AS CREATIVE AND INNOVATIVE STRATEGY

In modern business arena higher education provider is facing increased pressure that competitive advantage can be built not only with research but also through excellent in creative active teaching. Creative active teaching includes using case study method in classroom and preparing talent students for case competitions as innovative strategy in a manner that integrates curriculum objectives with learning outcomes.

Erskine (1998) defines case studies as “a description of a real event, which includes a decision, challenge, opportunity, problem or attitude with which a person or people in an organization are faced”. There are two main areas for using case study method in higher education in the classroom and case competitions. The implication is that the classroom needs to include active and interactive learning as the basis for developing understanding of core disciplinary concepts, and these underpin academic success with strong implications for student retention (Crosling et al, 2009.) Active learning is often associated with experiential, problem-based and project-based learning, and other forms of collaborative learning, and less reliance on the large lecture format. Problem-based and project-based learning promote collaboration among students to solve problems, and by using realistic problems or situations for learning, a deeper understanding of the relationship between theory and practice can be developed and understood by students. Considering Jelenc"s (2011) comparison study of using case methodology in classroom in the West (USA) and East (Croatia), it is crucial to point out that the role of the student in the West is to become a partner with the professor, while in the East the student has a subordinate role. Another important difference in applying the case study method is that students in Western countries are more stimulated to prepare themselves for the classroom and are motivated to actively participate. Furthermore, in the East students are usually not familiar with the material used in class and are less interested to learn. The main constraints of students in Serbia, as an eastern representative, with regard to the case method in classroom are: focus only on knowledge covered by the exam, lack of time to learn more and demotivation for active learning (Damnjanovic, 2011). This study will focus on case competition as innovative strategy approach.

However, applying active case learning at the case competition described an opportunity for undergraduate students to apply concepts they have recently seen in their coursework to „real world" business problems (Bale et al., 2013). Competitions enable students to deal with the challenge of delivering results under pressure, given an enigmatic real-world business problem. The Auckland University has compiled a list of results from past undergraduate international case competitions with invitation only from 2011 to 2016. This list contains information on the winner of the competition, as well as universities that came second and third (or made it to the final). Statistics show that number of global case competitions that are being organized yearly has increased from 13 in 2011 to 18 in 2015(The University of Auckland, 2016).

Our best practice from the Faculty of Organizational Science University of Belgrade with great results at the global level at the prestige case competitions from 2012 to 2016 enabled organizing The Belgrade Business International Case Competition. Belgrade Business International Case Competition is a global undergraduate business case competition organized by the Faculty of Organizational Sciences of the University of Belgrade since 2013 in South Eastern Europe. This competition consists of 16 leading business schools from all around the world (USA, Canada, Europe, Australia and Oceania, Asia) and the jury members, who evaluate student solutions in Power Point format, are practitioners and business consultants. Students have two cases to solve, the first one in five hours and the second one in 30 hours. They have 20 minutes for presenting their solutions, followed by 15 minutes of question-and-answer (BBICC, 2016).

Based on previous researches, case competitions have been shown to have multiple benefits for the students who are participating: managerial skills with focus on creativity and innovation, learning benefits and employability skills.

4.1.Managerial skills

According to Umble et al (2008) using team case projects in education can encourage the development of problem-solving skills, engender deeper and more critical and creative thinking, increase confidence, provide a context for the relevance of the subject matter, encourage group interaction. Students felt that the Consulting Challenge as case competition in Minnesota helped them be effective teammates, manage heavy workloads, apply theory, solve organizational problems, present a persuasive argument to a client, manage their emotions, answer difficult questions from a client, present creative ideas to a critical audience, perform

under short deadlines, manage time, complete large amount of work in a short time (Sachau and Naas, 2010).In order to use case competition to prepare students for the future work case study method helps students develop managerial skills: problem - solving approach, critical reasoning and analytical skills. Student participation in case study competitions can enhance their communication skills, making them more suited to negotiate an increasingly competitive work environment. (Burke at el, 2013).

In reviewing materials available in case competitions in South Eastern Europe - Serbia and Croatia (Damnjanovic and Dlacic, 2015) it is evident that skills that students' developed the most are teamwork skills and learning how to perform market research. The rest of the answers are distributed among developing creative thinking, developing presentation skills, identifying target markets, collaboration with companies, learning how to make decisions and identifying trends on the market. Considering the teamwork in business student case competition in Serbia, Radisic and Nedeljkovic (2012) point out the creativity and thinking out of box in brainstorming session are crucial for development of business ideas for company representatives in order to provide different solutions for companies. Brainstorming as the initial stage in case solving analysis include: everyone write ideas on paper, all ideas being equally valued by the decision making criteria and no criticism of other people's ideas is allowed. Besides learning individually, students from Serbia and Slovenia at case competitions are additionally improving their skills through interaction with their colleagues. Cases make learning relevant and meaningful to the student through active participation in analyzing, discussing and solving real problems (Todorovic at el, 2014)

4.2. Active Learning

Active learning benefits from cases approach usually recognized alignment of theory with practice, and using managerial tools for solving life problems. Cases make learning relevant and meaningful to the student through active participation in analyzing, discussing and solving real problems. Learning is moved from memorization of numerous facts to practical application of theories, concepts and techniques to real problems. Students are in a position to accumulate the knowledge and experience of older people, lecturers and jury members (Todorevic at el. 2014). Case study competitions expose students to real world experiences, encourage them to take ownership of their learning and help to assimilate their ideas into theory and practice (Burke at el, 2013). Furthermore, case studies not only make theory and principles meaningful and useful in practice but also provide specific knowledge and the ability to act in real life. The skills and knowledge attained from well-planned application of case studies are transferred and imposed on the student. Case studies improve personal integrity and the ability to choose right action with active learning through case competition. The case study thereby contributes to the realization of the aim of educating good managers and administrators (Rendtorff, 2015).According to research from New Zealand (Corner at el., 2006) case competition reflects the four elements of a grounded learning exercise. These elements are: creating a real-world experience, optimizing learning transfer, integrating theory and practice, and shifting learning responsibility to the students.

4.3. More attractive on the job market

Referring to potential employability skills case study competitions improve teamwork, critical thinking and communication skills, which are the skills that employers want from their new employees (Burke at el, 2013). Case competitions provide an opportunity to make business education meaningful to business students, while providing students an opportunity to prepare for upcoming career challenges. Competitions enable students to deal with the challenge of delivering results under pressure, given an enigmatic real-world business problem (Bale at el., 2013).Reflections from past participants suggest that the competition is a more memorable university experience than are obligatory prerequisites for career qualifications and better prepare students for future career (Ali at el., 2011, Damnjanovic, 2012).Lastly, the benefits for managers and company side from case competition are: potential employment - selection and recruiting of the best students and networking of organization that provide case with faculty.

4. CONCLUSION

An obsolete knowledge, competence and skills are the main obstacles to development of many organizations. The global dynamic business environment needs new entrant employees ready for the immediate start and in many companies there is no time for learning at working place. All of the given changes have an impact on the fact that business schools have to be competitive on the market of higher education, and have a leading role in terms of providing the “best” students for the “best” companies in the job market (Damnjanovic et al, 2014). Role of the business schools is in providing “a prepared citizen” (see Everett and Pege, 2013) is crucial for the future of the business. What is the future of the business? “It"s not

necessarily overnight shifts – they're ongoing and perpetual – but they're going to change everything the way we know it today. If you're not competing for the future, you're by definition competing for irrelevance" (see more in Clark, 2013).

The quality professionals lately point some key trends which are transforming the future of quality: *talent of people*, *creativity and innovation* or *knowledge and agility.* The quality profession needs "*leadership talent worldwide*" (Gutner and Adams, 2008) and the role of the quality professionals must become that of teacher and mentor, coach and player (Nash, 2014). Study of Power (2014) indicated that quality management in developing countries can still use existing knowledge to achieve improvements however innovative approaches are expected in the near future. Considering difference between students from Western and Eastern countries (Jelenc, 2011, Damnjanovic, 2011) such as: collaboration with professors, motivation to actively participate, familiarity with the material used in class and factual learning - the main constraints of students from Eastern European countries might be seen in absence of needed skills for global business. In the knowledge economy, critical to success skills of new entrants are: teamwork/collaboration, creativity and innovation, critical and thinking/problem solving, professionalism/work ethic, oral and written communications, information technology application, leadership and lifetime learning.

Even though future of higher education in area of the quality management is complex issue, the general strategies for the specific skills development should be based on new and innovative higher education. Creative active teaching includes using case study method in classroom and preparing talent students for case competitions as innovative strategy in a manner that integrates curriculum objectives with learning outcomes. Based on previous researches, case competitions have been shown to have multiple benefits for the students who are participating: improved managerial skills with focus on creativity and innovation, learning benefits and employability skills of the talent. Our best practice from the Faculty of Organizational Science University of Belgrade, with great results at the global level and the prestige case competitions from The Belgrade Business International Case Competition (BBICC) are the excellent starting point for recruiting the right talent.

REFERENCES

Adebanjo, D. (2001). TQM and business excellence: is there really a conflict?.Measuring Business Excellence, 5, 3, 37 – 40.Retrieved from: http://dx.doi.org/10.1108/13683040110403961

Ali, M.K.,Grund, J.M.&Koplan,J.P. (2011, April).Case competition to engage students in global health.Atlanta, 377, 1473.Retrieved from:www.thelancet.com

Aryanasl, A. J., Ghodousi, R., Arjmandi&N. Mansouri (2016).Can excellence management models encompass "cleaner production" and "sustainable business" revolution?(European Foundation for Quality Management as a case study). International Journal of Environmental Science and Technology, May 2016, 13, 5, 1269-1276.doi: 10.1007/s13762-016-0948-9

Bale, J.M.,Senteza, J.&White,T.A. (2013).A Model for Running an Undergraduate Business-Focused Case Competition.International Research Journal of Applied Finance, ISSN 2229 – 6891.1-16.Retrieved from: https://irjaf.com/uploads/IRJAF_case_studies_in_finance_and_accounting_Vol_II.pdf

Belgrade Business International Case Competition, 2015.Retrieved from: <http://www.bbicc.org/> [Accessed April 20, 2016]

BUREAU VERITAS, ISO9001:2015(2016). What are the main changes?.Retrieved from: http://www.isorevisions.com/iso-90012015-what-are-the-main-changes/

Burke, M.G., Carter, J.D.&Hughey W.A. (2013).The use of case study competitions to prepare students for the world of work.Industry & Higher Education, 27, 3,157–162. doi: 10.5367/ihe.2013.0156

Casares, Dickson, Hannigan, Hinton & Phelps (2011). The Future of Teaching and Learning in Higher Education, version 13. Rochester Institute of Technology.https://www.rit.edu/provost/sites/rit.edu.provost/files/future_of_teaching_and_learning_reportv13.pd, pp. 5-6

Corner, P.D. , Bowden, S., Clark, D., Collins, E., Gibb, J., Kearins, K.&Pavlovich K. (2006). Grounded learning from a strategy case competition.Journal Of Management Education.30, 431-454. doi: 10.1177/1052562905277789

Crosling, G., Heagney,M.& Liz, T. (2009).Improving student retention in higher education.Australian Universities' Review, 51, 2, 9 -18.

Dahlgaard-Park S. M. (2011). The quality movement: where are you going?.Total Quality Management, 22, 5, 493 –516. doi:10.1080/14783363.2011.578481

Dahlgaard-Parka S. M., Chi-KuangChenb ,Jiun-Yi Jangb& Jens J. Dahlgaard Total Quality Management,Diagnosing and prognosticating the quality movement – a review on the 25 years quality literature (1987 – 2011). 2013 24,1, 1–18, doi: http://dx.doi.org/10.1080/14783363.2012.756749

Damien J. & Power (2014).Competence and capability in quality in the high-tech sector: an international comparison.International Journal of Operations & Production Management, 34, 9, 1184 – 1209. doi: http://dx.doi.org/10.1108/IJOPM-06-2012-0232

Damnjanovic V. (2012).Challenges of using the case study method in marketing course and competition, Pranjana.The Journal of Management Awareness, 15,1,1-6.Print ISSN: 0971-9997. Online ISSN: 0974-0945.

Damnjanovic, V. &Dlačić J. (2015, October). Perceived Students' Benefits Of Case Study Learning In Marketing: Comparative Analysis Of Croatia And Serbia, 24th CROMAR Congress.ProceedingMarketing.Theory And Practice- Building Bridges And Fostering, Collaboration, Split, ISBN: 978-953-281-067-7, 252-268.

Damnjanovic, V.(2011).Marketing in Practice Applying the Case Study mm Method.Beograd, Excelsior FON.

Damnjanovic, V., CicvaricKostic, S. &Neskovic, E. (2014), Organizing Business Case Competition-Guidelines For Business Schools, Integral Review- A Journal of Management, 7, 2,1-18.

Davies J. (2008). Integration: is it the key to effective implementation of the EFQM Excellence Model?.International Journal of Quality&Reliability Management, 25, 4, 383 – 399.doi:http://dx.doi.org/10.1108/02656710810865267.

Erskine J. A., Leenders, M. R. &Mauffette-Leenders, L. A.(1998), Teaching with cases. Ontario: Ivey Publishin.

Everett D.L.&Page M. J.(2013).The Crucial Educational Fusion: Relevance, Rigor and Life Preparation in a Changong World. In G.M.Hardy et al.(eds).Shaping the Future of Business Education.Palgrave Macmillan Publishers Limited

Gómez I J. G., Costa M. M. &Lorente Á. R. M. (2011).A critical evaluation of the EFQM model.International Journal of Quality& Reliability Management, 28, 5.484 – 502.doi:10.1108/02656711111132544

Gutner T.& Adams M. (2008). Research Report: A Leadership Prescription for the Future of Quality. A Report from The Conference Board Quality Counci.

Jelenc, L.(2011). The case study method, Higher Education in South Eastern Europe.In: University-Economy Partnerships for Enhancing Knowledge Transfer, World University Service, Austria, pp. 38-47. Retrieved from: <http://www.wus-austria.org/files/docs/manual5_endps.pdf> [Accessed May 07, 2011]

Lowden Ke. (2011).Hall S. Employers' perceptions of the employability skills of new graduates.University of Glasgow SCRE Centre and Edge Foundation,ISBN 978-0-9565604-3-8.Retrieved from: http://www.edge.co.uk/media/63412/employability_skills_as_pdf_-_final_online_version.pdf

Lutz, W. (2011).Demographic challenges affecting business schools.Journal of Management Development, 30, 5, 2011, 463-473.doi:http://dx.doi.org/10.1108/02621711111132975

Meeker M. (2015).Internet Trends 2015 – Code Conference.KPCB, Retrieved from: http://www.kpcb.com/internet-trends.

Nash M. A. (2014).Quality Management for the Future, Old dogs can learn new tricks.QualityMagazin. October 2, 2014http://www.qualitymag.com/articles/92184-quality-management-for-the-future

OECD (2008).France International Conference Higher Education to 2030: What Futures for Quality Access in the Era of Globalisation?.Conference Speakers Biographies and Forward-looking Perspectives on Higher Education,Retrieved from: https://www.oecd.org/site/eduhe30/41801234.pdf

Radisic, M. &Nedeljkovic, A. (2012). 5 C model Business Case Solving Case Methodology. The New Educational Review, 27, 1.19-30.

Rendtorff, J. D. (2015).Case Studies, Ethics, Philosophy, and Liberal Learning for the Management Profession.Journal of Management Education, 39,1, 36– 55

Sachau, D.A.&Nass P. (2010). The Consulting Challenge: A Case Competition, Journal of Management Education.34, 4, 605– 631.doi: 10.1177/1052562915613589

Teichler, U. (1999). Internationalization As A Challenge For Higher Education In Europe.Tertiary Education and Management, 5, 5–23.

Todorovic, I., Komazec, S.&Pintar, R. (2014).Strategic implementation of case study courses and competitions for students.Serbian Project Management Journal, 4, 2, 50-59.

Umble,E.J.,Umble,M. &Artz, K. (2008).Enhancing Undergraduates' Capabilities Through Team-Based Competitions: The Edward Jones Challenge. Decision Sciences Journal of Innovative Education, 6,1, 1-27. doi:10.1111/j.1540-4609.2007.00164.x

University of Auckland undergraduate international case competition list. Retrieved from:http://www.business.auckland.ac.nz/en/for/current-students/uabs-champions-trophy/international-case-competition-results-2015.html, Accessed April 24, 2016.

SOFTWARE QUALITY ASSURANCE

Sara Marković*[1], Katarina Stojanović [2], Mladen Đurić[2]
[1]MERA Software Services, Belgrade, Serbia
[2]University of Belgrade, Faculty of Organizational Sciences
* Corresponding author, e-mail: sara@zovime.com

Abstract: *This paper analyzes the approaches of quality management in the software industry and emphasizes the application of quality concepts in software development, which includes the key elements necessary for the survival of an organization and its growth. The paper also shades some light on the ways quality management principles are applied throughout all stages of software development. It also elaborates in one of the specialized and belonging disciplines, such as: software testing. In this context, various aspects in the field of quality assurance in software development: methods and techniques of software testing and software lifecycle are described. In the paper is given compared quality management principles and principles of software development.*

Keywords*: quality assurance, software, testing, CMMI, PDCA, quality documentation, process approach*

1. INTRODUCTION

This paper is about different quality management approaches in software industry. Use of quality in software development is essential for advancement and development of a company, especially if one of the goals is long-term business success.

It is necessary to make a distinction between testing and software quality assurance, as well as what can be achieved by software testing. Each project has its beginning and end, which is also the case with software development. Which phases of development is software going through and can those phases apply not only to software development, but also to other products we want to successfully place on the market?

Why is the process approach important and how can the direct connection between this approach and Deming's well known cycle be made? What is test plan, test case and software quality assurance plan and why is the documentation in software development usually formatted like this?

Some of the most common methods and techniques in the field of testing and quality assurance will be mentioned. In order to ensure software quality, as already mentioned, it is necessary to conduct software testing. Black and white box methods are essential in order for tester to start testing process.

Software industry is engaged in development, maintenance and software delivery, as well as related services such as trainings, documentation, advising and support for software use. Software testing consists of verification and validation correctness of the software itself, but it also identifies important defects, errors caused by people or environment, lack of knowledge or mistakes in the application code.

Software development process includes:

- Definition and detailed documents for development
- Prototype as a proof – concept
- Presentation of prototypes and correction of products (if necessary)
- Software encryption and code verification
- Individual product testing

2. PHASES IN SOFTWARE DEVELOPMENT

Each phase of software development should be tested in order to ensure quality of end product. So

in each of those phases quality can be ensured by testing. Testing without preparation, which is mostly for informational purposes, is called walkthrough.

Inspection is more formal than casual testing and it usually includes three to eight experts. The subjects of supervision are phases of development that are documented and specified and the goal is to find the lack but not to be removed. Participants should prepare for this type of check by reading the documentation and procedures where all of the development steps are being defined. The result of inspection is also written report.

There is a huge similarity with internal check from ISO 9001:2008 where it says - „The organization shall: plan, establish, implement and maintain an audit programme(s) including the frequency, methods, responsibilities, planning requirements and reporting, which shall take into consideration the importance of the processes concerned, changes affecting the organization, and the results of previous audits."
Planning, analysis, design, implementation and testing are the phases through which the software evolves. From a conceptual phase to delivery, software must be monitored and tested in order to prevent problems to happen. The earlier you recognize the potential defect or defect itself, debugging will be more efficient and with lower costs.

Three famous models of software development are:

- Waterfall model
- V-model
- Spiral model

Waterfall model is the oldest and most commonly used model. It follows software development through all phases, characterized by clearly identified user requirements, procedures with clearly defined development processes where any deviation can cause an error or bag. In more traditional models, such as the waterfall model, the testing phase is done after defining the requirements and when the encoding process is completed. However, this practice is obsolete, and even though the testing phase is the last phase, it is used at all phases of development so that each phase can be well tested and ready to make it to the next phase.

3. TESTING AND QUALITY ASSURANCE IN SOFTWARE DEVELOPMENT

It is necessary to make a difference between testing and software quality assurance. *Jonassen Hass (2008) says that testing is an activity that can be applied in all phases of software development in order to secure software quality as the main goal and that testing involves system or application operations under defined conditions and evaluation of system's testing results.* What makes testing interesting is creating such conditions where things will go wrong, in order to determine when and why software doesn't work and its correctness or malfunction if the software doesn't respond to changed conditions. (ie. will Facebook homepage start if username and password are not entered; if it starts under those conditions, that can cause huge privacy concerns.)

Software testing is process of validations and verification in order to prove that:

1) Software meets business and technical requirements
2) Software works as planned.

Muyers, Badgett and Sandler (2012), describe software testing as identifying defects and mistakes that must be corrected, therefore, from the perspective of the end user, mistakes and defects must be removed so the functionality of software isn't changed or damaged.

As Desikan and Ramesh (2008) describe, software testing can give an answer to some of these questions:

- *Does software really work as expected?*
- *Are the user requirements met?*
- *Are users satisfied?*
- *How does it work and is it "user friendly"?*

- *How does it react when it's being used by many people at the same time?*
- *Which parts of software have to be improved?*
- *Is it ready for delivery to the end user?*

Software quality assurance includes whole process of software development, tracking and process improvement, making sure da each process, standard and procedure are being followed. Quality assurance ensures that the process is noticed in the early stage of development and the team of experts was involved in removing the potential or existing problem. Quality assurance is focusing on "preventive action". Software quality assurance can provide complex approach to maintenance, not only in the context of eliminating mistakes, but also:

- Work on re-engineering solutions that meet new requirements of the market
- Solutions improvement
- Contribution to the overall evolution of the solution through the implementation of proactive analysis of key causes for all critical questions,
- Quality improvements of original solution through refactoring the original code, etc.

Definition proposed by ISO standards for software quality (ISO/IEC 2001, 2003a, b, 2004) says that *"QA is a measurable physical or abstract property of software product that bears on its ability to satisfy stated and implied needs"*. According to *Balasubramaniam et al. (2009), "achieving QAs in SBS is critical due to the following reasons:*
• *Application developers need to be confident that the services (and compositions of them) will meet end user quality requirements.*
• *"Application developers need to understand the cost and risk of achieving quality requirements, given that system QAs often must be traded off or built in" (O'Brien et al. 2007).*
• Application developers require information for selecting between alternate services with similar functional capability.
• Application developers require information about Quality of Service (QoS) to monitor and enforce service level agreements (SLAs).

4. QUALITY IN SOFTWARE DEVELOPMENT

Software quality implies the absence of bugs in the software, delivering at the right time and to the right place with minimal costs, the software that meets the requirements and expectations of users and that is suitable for maintenance. But quality is a subjective term. It depends on who is the software's end user and what is its impact on the development phase. The end user may be a foreign buyer, internal tester that gives a confirmation for the further development, the employer of organization itself, shareholders, etc. The perception of quality depends of priorities and requirements of the end user.

4.1. The use of CMMI maturity model

Falessi, Shaw and Mullen (2014) point out that five levels of "maturity" process model helps in providing the efficiency in quality software delivery. CMMI models are collections of best practices that help organizations to identify and improve their processes. That model is focused on larger organizations. However, many of the quality processes are generic and applicable to all organizations, regardless of the size and complexity. Organizations can obtain an estimation of CMMI maturity levels by authorized valuators, or it can be conducted by organization itself.

Maturity levels:

- ✓ At the *initial level*, processes are disorganized, even chaotic. Success is likely to depend on individual efforts, and is not considered to be repeatable, because processes would not be sufficiently defined and documented to allow them to be replicated.

- ✓ At the *repeatable level*, basic project management techniques are established, and successes could be repeated, because the requisite processes would have been made established, defined, and documented.
- ✓ At the *defined level*, an organization has developed its own standard software process through greater attention to documentation, standardization, and integration.
- ✓ At the *managed level*, an organization monitors and controls its own processes through data collection and analysis.
- ✓ At the *optimizing level*, processes are constantly being improved through monitoring feedback from current processes and introducing innovative processes to better serve the organization's particular needs.

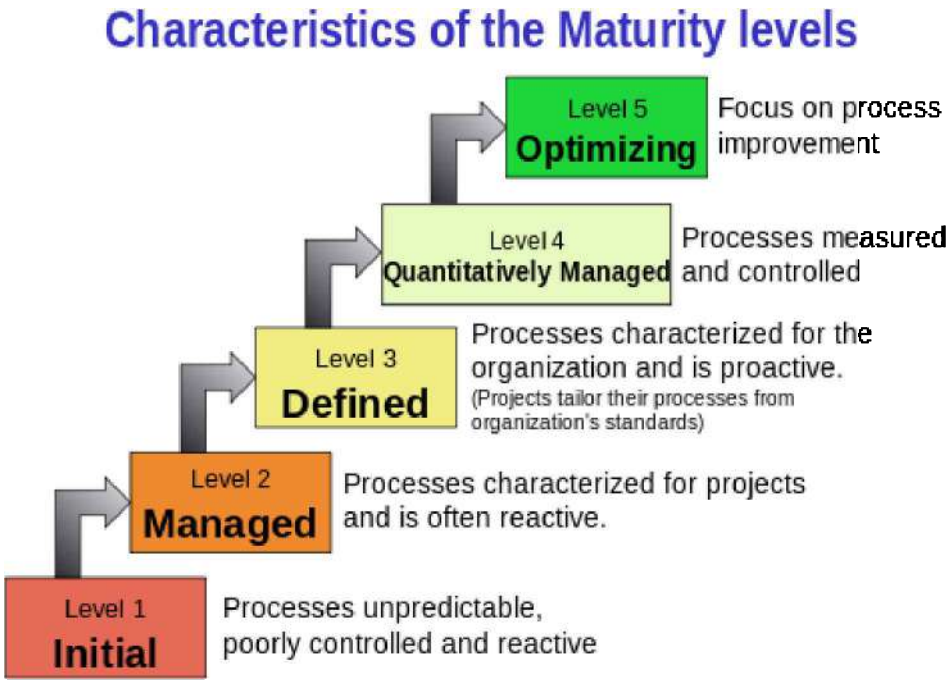


Figure 1. CMMI Maturity Model Levels - Falessi, Shaw and Mullen (2014)

4.2. Introduction of quality assurance process in organization

The introduction of quality assurance processes in the organization depends on the size of the organization and possible risks. For larger organizations with high-risk projects, formal processes of quality assurance and great commitment of the management is necessary. Not only the leadership but all employees must be aware of the importance of introducing quality processes and they have to be involved in the introduction of these processes. Communication between users, testers, programmers and managers must be adequately permeated throughout the organization, because of the cooperation and regular communication is the basis for coordination and improvement of business processes.

Other possibilities for the introduction of process quality can be seen in the implementation of different approaches, such as Kaizen - a method of continuous process improvement, Deming's method Plan-Do-Check-Act and many others.

Example model of Deming's PDCA (Plan-Do-Check-Act) in software development

Company "Mera" is in charge of software production. One of the clients ordered a software as a desktop application for the computer. The application is called Team Tracker, which is used as an internal application, where employees can enter their work tasks, time spent on working on activities, time spent outside the company (having a break), vacation planning, problems and plans for the next day.

Application of PDCA cycle is given below as an example.

Plan

Company "Mera" has found his client's claims:

- Making daily reports
- Launching applications quickly and easily
- Transparency commands
- Relation with other operating system
- Expansion possibilities, introduction of new options
- Easy maintenance

Do

Processes are being realized and mistakes are being processed simultaneously.

Check

Process performances are being monitored and measured. Mistakes and bugs are identified. It is checked if application is working in the required environment and whether it can operate in alternative environment.

Act

Continuous improvement of process performances. It is possible to give certain remarks and comments, it is important that both employees and end users are being involved. New solutions or edit of the existing ones are being proposed. Every employee has the right to propose improvements. Degrees of influence are being determined - how much influence do certain software features have on individual customer requirements. Standardization of process or the introduction of a model of maturity is being conducted.

4.3. The role of documentation in providing software quality

Processes of quality assurance should be documented to ensure the repeatability of success. Specifications, standards, schemes, business rules, configurations, test plans, test cases, reports, manuals etc. should be documented in some form (electronic, paper…).
Based on the good documentation, the system can be set up where certain information can be easily found. Documentation often becomes more important when it comes to long term projects.

What is test plan, test case and software quality assurance plan?

"Test plan is a document which consists of basic information about testing and it is describing objectives, scope, approach and focus which help in software testing approach", Filipovic and Djuric (2009) point out. The process of preparing the test plan is useful way of thinking which phases software should go through, which methods are used and what are the expected test results.

Test plan includes:

- Name
- Version of the software that is being tested,
- Document audit that includes test plan makers, date, who approved it,
- Content
- The purpose of the document and to whom it is intended,
- Testing objective
- Description of the software that is being tested
- Relevant documents that is connected with test plan, such as standards, procedures, project documentation and other test plans,
- Traceability requirements
- Test team,
- Scope and limitations of testing,
- Risk analysis,

- Results
- Additions, vocabulary, abbreviations, etc.

Filipovic and Djuric (2009) explaine that "test case is a collection of different environmental conditions under which the software is being tested and it's being determined whether software system or its part works as planned." They also point that it must describe the desired result. Test case won't be evaluated if there is no defined statement about the expected output.
It describes the entrance, action or event and the expected result in order to determine whether the characteristics of software application work correctly.

Test case can consist of information such as:
- Test number
- Test name
- Creation date
- Test description
- Objective
- Test conditions
- Requirements necessary to perform the test
- Steps of implementation
- Expected results

The level of detail can vary depending on the organization and project. Organizations often use less detailed test cases that allow documentation that is simple and more flexible, that refers to test implementation.

Test developing processes can help find problems in requirements or application design because it requires thinking about how exactly the application will work. Because of that, it is useful to prepare tests at early stage of software development, if possible.

5. TESTING METHODS OF SOFTWARE QUALITY ASSURANCE

Burnstein (2003) said there are many ways and testing methods of software quality assurance, such as:

Black box testing - does not require knowledge of the inner code design or how the application is being programmed. Basic functionality and compliance with the requirements are being tested.

White box testing - based on knowledge of the internal logic and application code. The internal code, algorithms, environmental conditions, etc. are being tested.

Alpha testing - application testing before the end of development process; minor design changes can also be the reason of such testing. Usually the alpha testing is done by end users, not programmers or testers.

Beta testing – it's done when the development and all necessary testing are completed; bugs and problems need to be found before the final delivery to the user. It is usually done by end users, not programmers or testers.

Mutation testing - a method for determining whether existing tests are useful even when some changes (errors) are deliberately made. Changed (muted) parts of application are being tested again using the original tests, to determine detected errors, which are expected because they are deliberately made changes ie. mutations.

Sanity / smoke testing - the simplest initial testing of basic functionality of the application components. If such testing proves to be reasonable, or if the results are acceptable, it is sent to the next phase of testing.

Load testing - testing of the application under load when it's being used by multiple users or when it opens simultaneously with other applications, to determine at what point an application stops working

due to the overload.

Recovery testing - How and for how long the system is recovering from a crash, hardware failures, or other catastrophic problems.

6. THE PRINCIPLES OF QUALITY MANAGEMENT AND SOFTWARE DEVELOPMENT

Filipovic and Djuric (2010) say that "The eight quality management principles represent a comprehensive, fundamental rules followed by the organization, with the goal of continual improvement of performance relevant for customers and other stakeholders."
Those are:
1. Customer focus
2. Leadership
3. Involvement of people
4. Process approach
5. System approach to management
6. Continual improvement
7. Factual approach to decision making
8. Mutually beneficial supplier relationships

Jung, Seung-Gweon and Chang-Shin (2004) point out that, as is known to software engineering experts, the ISO/IEC 9126 was a long run software evaluation standard which dealt with a quality of software products, "by presenting an appropriate framework for modeling the processes by segregating quality dimensions into six categories (functionality, reliability, usability, efficiency, maintainability, portability), consequently divided into 27 smaller groups."

Polillo (2012) claims that "these processes should lead to better customer satisfaction with the software quality, while within the organization they serve as enablers for understanding of software quality dimensions and open space for new improvements." Recently, this standard has been replaced by the newer version entitled ISO/IEC 25010:2011.

6.1. Focusing on the customer

By ISO 9000:2015 customer satisfaction is the "customer's opinion of the level to which the customer's requirements are being met." "Organizations depend on their customers and therefore should understand their current and future needs, the need to meet their requirements and strive to overcome their expectations."
Customer satisfaction is achieved when goods and services match or overcome the demands and needs of the user. Therefore, all processes and all employees in the organization must be focused to users. In software development, quality is defined by group (users, clients or customers) which software is dedicated to and organization should identify their stated and possibly unexpressed needs and approaches to software development in a way to satisfy customers.
Essential aspects of focusing on users are:
• Understanding clients' needs and overcoming their expectations,
• Taking responsibility for customer satisfaction, so the quality of service the highest priority,
• Confidentiality of information, intellectual property protection and business reputation: own and reputation of users.

Measuring customer satisfaction can be achieved in various ways, by using direct (surveys) and indirect (Monitoring Body) methods. For example, the software company "Mera" uses methods of colors - next to the each software features is green, yellow or red color, representing satisfied, medium satisfied or dissatisfied users.

"Recently, the User Experience concept (UX) has become more used than usability in the Human Computer Interaction (HCI) discipline and SQUARE (Systems and Software Quality Requirements and Evaluation) [1] is the standard that defines the system quality or the software quality. Nevertheless, HCI practitioners still have not come to an agreement about defining UX. Also, the standard attributes which researchers use for analyzing the UX in a specific interactive system do not exist. For these reasons, the main aim of this research is the specification of UX based on the facets

that the ISO/IEC 2010:2011 considers according to its attributes." (Masip, Oliva and Granollers, 2011)

6.2. Staff involvement

ISO 9000:2015 says that "the staff at all levels makes an essential part of an organization and their full involvement enables to take advantage of all capabilities for the organization's benefit."
It is good idea to listen to ideas, suggestions and comments of employees, because everyone has some additional features, knowledge and skills. Opinions of programmers and testers should be considered, because together they can come up with the right solution. It is well known that if a thing is being impartial observed, better conclusions and solution proposals can be made. A new idea can easily be accepted, does not only applies to projects, but also to the policy of the company, interpersonal relationships etc. Employees should be treated with respect and their rights have to be protected. It is necessary to create equal conditions for employees with the same qualifications.

6.3. Process and system approach to management

In ISO 9000:2015 is said that "the desired results can be achieved more efficiently, if the management of certain activities and resources is done through processes."

The use of this principle leads to lower costs and shorter software development time and respect deadlines for testing and delivery, more efficient use of resources, improved and predictable results, prevention of the possible occurrence of errors or bugs, creating more capable workforce, establishing clear responsibilities and competencies for managing key activities.
Process approach in software development means that processes are defined, managed and measured.

"Identifying and understanding of a system of interconnected processes, and management of that system, contribute to the effectiveness and efficiency of the organization in achieving its goals" as defined in ISO 9000:2015.
The purpose of the quality management system is to achieve customer satisfaction.

Key advantages of this principle are: the creation of comprehensive plans that include test plans, integration process through the stages of software development, the ability to focus all efforts on the key processes that need to be tested in particular, a better understanding of the errors causes and taking timely actions to prevent or remove the deficiency.

7. CONCLUSION

From all mentioned in this paper it can be concluded that use of quality has a major impact on business processes, which are of prime importance for the success of an organization.

Through this paper is explained the application of quality in software development.

The basic difference between the software testing and software quality assurance and that testing is an activity that can be applied at all stages of software development, in order to ensure software quality. Quality assurance can influence on costs reduction, process efficiency improvement, because the software that was delivered to the user's perception of quality, will definitely be adequately valued in the market.

Successful software has successfully passed through all stages of development, and by testing each stage quality of parts and then the final product or software can be provided. The application of Deming PDCA cycle in direct application production that is delivered to user after the last phase of development and testing is shown.

Some of the most common methods and techniques in the field of testing and quality assurance are explained. It is necessary to implement software testing to ensure its quality.

REFERENCES:

Balasubramaniam, S., Lewis, G. A., Morris, E., Simanta, S., and Smith, D. B. (2009), Challenges for assuring quality of service in a service-oriented environment. In 2009 ICSE workshop on principles of engineering service oriented systems, 103–106. Vancouver, Canada: IEEE Computer Society.

Desikan S. and Ramesh G., (2008), Software Testing – Principles and Practices, Dorling Kindersley, Pvt. Ltd., India.

Falessi D., Shaw M. and Mullen K., (2014), *Achieving and Maintaining CMMI Maturity Level 5 in a Small Organization,* 80-86.

Filipovic J. and Djuric M., (2009*), Fundamentals of Quality*, Faculty of Organizational Sciences, Belgrade, 2009.

Filipovic J. and Djuric M., (2010), *Quality Management System*, Faculty of Organizational Sciences, Belgrade, 2010.

Ilene Burnstein, (2003), Practical software testing, Springer-Verlag New York, Inc

ISO (2015), ISO 9000 - Quality management systems - Fundamentals and vocabulary, International Organization for Standardization (ISO)

ISO (2008), ISO 9001 – Quality management systems – Requirements, International Organization for Standardization (ISO)

ISO/IEC. (2001). Software engineering—Product quality—Part 1: Quality model. Vol. ISO/IEC 9126-1, Geneva, Switzerland.

ISO/IEC. (2003a) Software engineering—Product quality—Part 2: External metrics, 86, Geneva, Switzerland.

ISO/IEC. (2003b). Software engineering—Product quality—Part 3: Internal metrics, 62, Geneva, Switzerland.

ISO/IEC3. (2004). Software engineering—Product quality—Part 4: Quality in use metrics, 59, Geneva, Switzerland.

Jonassen Hass A.M., (2008), *Guide to Advanced Software Testing*, ARTECH HOUSE, INC.

Jung Ho-Won, Seung-Gweon Kim, Chang-Shin Chung (2004), Measuring Software Product Quality: A Survey of ISO/IEC 9126, *IEEE Software*, vol.21, no. 5, 88-92, September/October 2004

Masip L, Oliva M. and Granollers T., (2011), User Experience Specification through Quality Attributes, *INTERACT*, 656–660.

Muyers G., Badgett T. and Sandler C., (2012), *The Art of Software*, John Wiley & Sons, Inc., Hoboken, New Jersey

O'Brien, L., Merson, P., and Bass, L. (2007). Quality attributes for service-oriented architectures. In International workshop on systems development in SOA environments, pp. 1–7. Minneapolis, MN: IEEE Computer Society.

Polillo R. (2012), A core quality model for web applications, *Journal of Web Engineering,* Volume 11, Issue 3, September 2012, pp. 181-208

SOFTWARE ENGINEERING 1252

GENERAL CONCEPT OF THE PLATFORM INDEPENDENCY MODEL 1253
Vlajić Siniša, Antović Ilija, Savić Dušan

DEVELOPING ANDROID APPLICATION FOR LEARNING DATABASE DESIGN 1263
Lazarević Saša, Stanišić Igor

COMPARATIVE ANALYSIS OF UML MODELING TOOLS WITH FOCUS ON BUSINESS LOGIC SPECIFICATION 1272
Stanojević Vojislav, Lazarević Saša, Milić Miloš

A POSSIBLE APPROACH TO AUTOMATING THE DESIGN OF NOSQL DOCUMENT-ORIENTED DATABASES 1281
Stojimirović Dejan, Nešković Siniša, Turajlić Nina

SOFTWARE ENGINEERING

GENERAL CONCEPT OF THE PLATFORM INDEPENDENCY MODEL

Siniša Vlajić[1], Ilija Antović*[1], Dušan Savić[1]
[1]University of Belgrade, Faculty of Organizational Sciences
*Corresponding author, e-mail: ilijaa@fon.bg.ac.rs

Abstract: *This paper presents the ways and types of interpretation of the concept of the platform independency, as well as the tools and mechanisms of its realization in real world environment. The paper introduces General Concept of the Independency (GCoI) model. The model is derived from most important platform independence mechanisms. The paper identifies four key mechanisms for achieving platform independence, and all of them are described using GCoI model. The GCoI model represents the fundamental concept that lies behind the platform independence.*

Keywords*: platform independency, General Concept of the Independency (GCoI) model, mechanisms for achieving platform independence, software engineering, platform independent software architecture*

1. INTRODUCTION

Appearance of new software architectures (Liu et al. 2011; Bass, Clements and Kazman, 2003; Gorton, 2011) and software platforms, especially in context of cloud computing approach, impose the need and challenge for identification and understanding of concepts and mechanisms which enables integration and adjustments in heterogeneous environments.

The main goal of this paper is to identify the mechanisms for achieving independency between software architectures and software platforms. While developing new platform or software architecture, engineers should be aware of all necessary elements that need to exist in order to achieve platform independence. In that sense, we will first try to define platform independent architectures and to identify main characteristics software architecture needs to poses in order to be considered as platform independent. In addition, we will try to classify the types of platform independence, and to identify mechanisms that are used for achieving each type of platform independence. By analyzing identified mechanisms, we will establish a general model for achieving platform independence. We will use platform independent architectures such as SOA (Vitvar et al. 2007; Erl, 2005), COA (Gorton, 2011), and MDA (Meghan; Object Management Group, 2003), and most important software platforms Java and .NET as examples for practical explanation of the general model for platform independence.

In this paper, we defined and explained the platform and platform independent software architectures and referred to the main problems in platform independent software development in the section2. Section 3 introduces the platform independent classification. This classification is based on noted relationships between software architecture and software platform from which we derivate different type of platform independency. The next section, describes four key mechanisms used for platform independency. Each of these mechanisms is explained by the General Concept of the Independency (GCoI) model. The GCoI model represents the fundamental concept that lies behind the platform independence and in the last section (section 5) authors point out importance of this model and emphasize future directions of research.

2. THE PLATFORM INDEPENDENCE

This section defines and explains the platform and the platform independence concepts as well as platform independent software architectures. It also discusses key concepts related to platform independence and objectives that lead to its realization. The part of this section refers to the main cause of platform independence implementation problems.

2.1. Definition of platform

The platform independence and platform as a concept appear in a various segments of the software engineering science. Consideration of the platform independence concept begins with considering the concept of platforms and their basic classification.

According to Object Management Group, a platform is defined as:
"Set of subsystems/technologies that provide a coherent set of functionality through interfaces and specified usage patterns that any subsystem that depends on the platform can use without concern for the details of how the functionality provided by the platform is implemented (Object Management Group, 2003)

A typical definition of a platform is: *A platform is a combination of hardware and software used to run software applications. A platform can be described simply as an operating system or computer architecture, or it could be the combination of both.*

There are two basic types of platform:

- A hardware platform can refer to a computer architecture or processor architecture. For example, the x86 and x86-64 CPUs make up one of the most common computer architectures for general-purpose computers.
- Software platforms can either be an operating system (Microsoft Windows, Linux, Mac) or implementation technologies, though more commonly it is a combination of both. Java and .NET are software platforms; they represent a set of technologies and programming languages, which together with specialized development environments enable the development of complex software systems. Java and .NET represent platforms that enable applications (implemented using these technologies), to work on multiple operating systems and hardware platforms.

A platform represents a subsystem or a set of subsystems that provide certain functionality. Platforms represent foundation for execution of other software systems and applications. The Figure 1. illustrates the basic platforms classification.

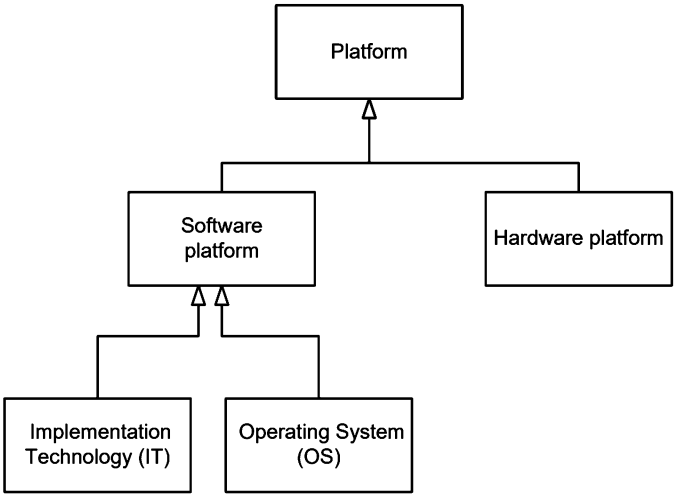


Figure 1: Basic platform classification

2.2. Platform independent software architectures: definition and characteristics

In its strict sense, a software architecture is "a description of the subsystems and components of a software system and the relationships between them." (Buschmann et al. 1996) Software architectures that will be further discussed are Model Driven Architecture – MDA (Meghan), Component Oriented Architecture – COA (Gorton, 2011) and Service-Oriented Architecture - SOA (Erl, 2005).

The platform independent software architecture does not include any specifics of implementation technologies, nor the details of target hardware platforms or operating systems on which software applications executes.

The platform independent software architecture should meet the following requirements:

- Platform independent software architecture does not contain details relating to the hardware platform on which software executes.
- Platform independent software architecture does not contain details relating to the operating system on which the software executes.
- Platform independent software architecture does not contain details relating to the implementation technology.
- Platform independent software architectures are specified with universally accepted languages for software systems specification.
- Platform independent software architectures can have large number of implementations.
- Platform independent software architectures are based on platform abstraction.

Because implementation and target platform details are excluded, the participants in the development process may focus on the key and essential aspects of software architecture and software systems. Also, it is much easier to explain the architecture to non technical people, who have interest or influence on the software systems financing and implementation.

Universally accepted notation and method makes platform independent software architectures important in understanding the software system and making the communication more comfortable.

2.3. Platform independence concept: goals and importance

The concept of platform independence is related to the concepts of portability, reusability, universality and financial viability. Portability, multiple usage and financial viability can be considered as primary objectives for realization of platform independent software architecture.

Universal and widely accepted rules have not been changed as quickly as the hardware platforms, operating systems or technologies. Universally accepted principles often go beyond the boundaries of time and space in which they have appeared. Platform independent software architectures tend not to obsolete rapidly, because they keep the knowledge and experience accumulated over years and generations, knowledge that can be reused in a number of situations. Such architectures are strong foundation for future development of software systems.

Based on the above mentioned we can conclude: The ultimate goal of platform independence realization is software applications that can run on many operating systems and hardware platforms, without modification or adaptation. Such solutions have maximum portability level.

The ultimate objectives of the software architecture platform independence realization in respect to the software platform are:

- Provide that the same software architecture can be used for various implementations using different technologies.
- Protect the results of software design process from the danger of rapid obsolescence, caused by the changes in technology, operating systems and hardware platforms area or platforms of any kind.

3. THE PLATFORM INDEPENDENCE CLASSIFICATION

While considering platform independence, it is necessary to specify the type of platform independence to which the review relates. Therefore, in this paper, we often use terms ”**which/what”** is independent **"in respect to" "what"** with the term and concept of platform independence**.**

Independence can be achieved in respect to:

- Software platform or
- Hardware platform
- Within the software platform, we distinguish:
- Operating systems
- Implementation technologies

Platform can be observed as software or hardware platform. We make distinction between implementation technologies as a platform (like Java and .Net) and operating system as a platform. The implementation technology is executed on an operating system while the operating system is executed on some hardware platform. Software system is based on software architecture, and is implemented using concrete implementation technology and it executes on some operation system.

Based on the above-mentioned relationships between software architecture and software platform, the following basic classification of platform independence is derived:

- PI1 – Independence of software architecture in respect to the implementation technology
- In this category, we have particularly considered:
  - PI11 – Independence of MDA in respect to the implementation technology
  - PI12 – Independence of COA in respect to the implementation technology
  - PI13 – Independence of SOA in respect to the implementation technology
- PI2 – Independence of implementation technology in respect to operating system
- PI3 - Independence of operating system in respect to hardware platform

4. THE PLATFORM INDEPENDENCE REALIZATION MECHANISMS

In this section, we have described four key mechanisms used for platform independency:

1. Services-based mechanism
2. Component-based mechanism
3. Model-based mechanism
4. Virtual machine-based mechanism

These mechanisms are presented below on the Figure 2.

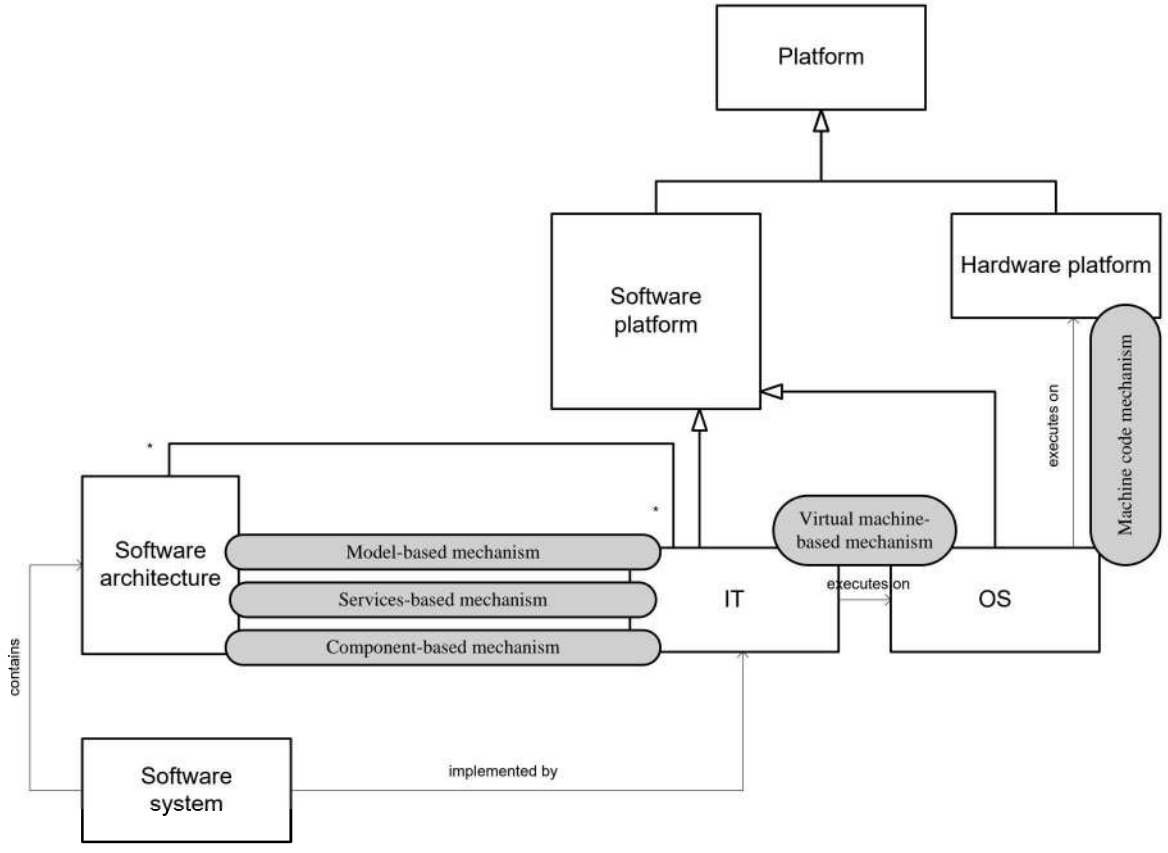


Figure 2: The relationships among software application, software architecture and platform

Model-based mechanism, services-based mechanism as well as **component-based mechanism** is used in achieving the independence of software architecture in respect to software platform.

Virtual machine-based mechanism is used in achieving the independence of the implementation technology in respect to the operating system on which the software system executes. The independence between software architecture and operating system is achieved indirectly (transitive relation) using this mechanism.

In addition to these four mechanisms that are covered in detail in the paper we have also identified the **mechanism of machine language** that enables operating system independence in respect to the hardware platform. In this paper, we have not specifically discussed about this mechanism. The independence between software architecture and hardware platform is achieved indirectly (transitive relation) using this mechanism.

Each of these mechanisms will be explained by the General Concept of the Independency (GCoI) model, which is presented on the Figure 3.

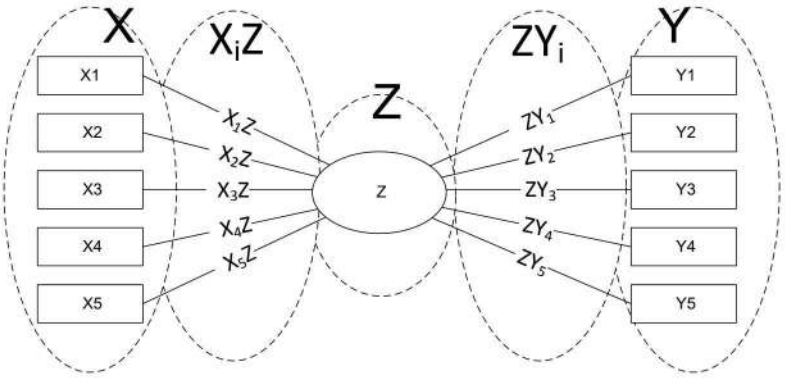


Figure 3. General Concept of the Independency (GCoI) model

The GCoI model represents the fundamental concept that lies behind the platform independence. The model consists of five elements (X, XZ, Z, ZY,Y). For each type of platform independence (PI1, PI2 and PI3), we have identified X and Y as elements between which we want to establish independence. X and Y can be observed as pair of software architecture (SOA, COA, MDA) and implementation technology (Java, .Net) in PI1, or as a pair of implementation technology (Java, .Net) and operating system (Windows2000,WindowsXP, Linux) in PI2 as well as pair of operating system (Windows2000, Linux) and hardware platform (x86 PC, AS/400) in PI3. In order to achieve independency between X and Y we have introduced independent component Z. Each element from sets X and Y should have different transformation to Z (XiZ or ZYj, i=1..n, j=1..m). If XiZ and ZYj exists, we can say that set X is independent to set Y.

Therefore, contrary to dependencies between every element from X (X1..Xn) to every element from Y (Y1 …Ym), these elements are only dependent on Z element. The GCoI model can be observed from two different aspects: as structure when we consider all the elements involved in achieving independency or as process of transformation between elements of set X and elements of set Y.

GCoI model can be applied to different mechanisms for achieving platform independence. If we consider Christopher Alexander's definition of patterns (Christopher et al. 1997), we can conclude that GCoI model obey this definition, and can be observed as a pattern. In software engineering, patterns are largely used for solving the problem of dependencies (coupling) between classes and objects. For creating maintainable software systems, it is important to reduce coupling as much as possible. The following part of this section describes mechanisms for achieving platform independence through GCoI model.

Services-based mechanism is used in achieving the independence of software components usually implemented as services (e.g. Web Services) using an implementation technology in respect to components implemented by another implementation technology.

Service-Orientated Computing (SOC) has become a main trend in software engineering that promotes the construction of applications based on the notion of services (Erl, 2005; Jonathan et al. 2008).

Web services provide a standard means of interoperating between different software applications, running on a variety of platforms and/or frameworks. A Web service is a software system designed to support interoperable machine-to-machine interaction over a network. It has an interface described in a machine-process format (specifically WSDL). Other systems interact with the Web service in a manner prescribed by its description using SOAP messages, typically conveyed using HTTP with an XML serialization in conjunction with other Web-related standards.

We have observed characteristics of web services, and ways of achieving platform independence in two different times:

1. Development time and
2. Runtime.

It is important to analyze both situations because in each of those we can notice different technologies, transformations, protocols, languages, but the same principle. This principle conform to the GCoI model.

According to General Concept of the Independency (GCoI) model, we have identified key elements of services-based mechanism, which are shown on the table below.

When we observe web service in development time, we can notice that both sides – provider agent and requestor agent can be developed using different technologies. Table 1 presents these elements.

Table 1. Services-based mechanism applied WS in development time

X - provider agent	**XZ**	**Z**	**ZY**	**Y-** requestor agent
Java	wsgen	WSDL	wsimport	Java
.Net	wsdl		wsdl	.Net
C++	wsdl2h		soapcpp2	C++
Delphi	delphi IDE		Delphi IDE wsdl importer	Delphi

Both sides need to have access to the WSDL document (Table 1, column Z). With access to the WSDL document both sides can generate programming code for components that will be used in runtime to establish communication (Table 1, column XZ – tools for generating components for provider agent, column ZY – tools for generating components for requestor agent). In this way, the XML based WSDL document stays the only component that gathers different technologies together and allows platform independent development of provider and requestor agents.

When we observe web services in runtime, platform independence is achieved using SOAP (Table 2).

Table 2. Services-based mechanism applied WS in runtime time

X - provider agent	**XZ**	**Z**	**ZY**	**Y-** requestor agent
Java	SOAP	SOAP Message	SOAP	Java
.Net				.Net
C++				C++
Delphi				Delphi

When the requestor agent calls some functionality of web service, the request is transformed into SOAP message (Table 2, column Z), and delivered to provider agent most commonly using HTTP protocol. The SOAP message is then transformed into platform specific call to provider component that will execute requested functionality, and optionally create the response and send it to requestor agent in the same manner.

Component-based mechanism is used in achieving the independence of software components usually implemented as services (e.g. CORBA) using an implementation technology in respect to components implemented by another implementation technology.

Development of software that is reliable, efficient and highly flexible, component-based software development can be employed for the complex software systems. (Jonathan et al. 2008) The Common Object Request Broker Architecture (CORBA) is a standard defined by the Object Management Group (OMG) that enables software components written in multiple computer languages and running on multiple computers to work together (i.e., it supports multiple platforms). It provides a platform-independent, language-independent architecture for writing distributed, object-oriented applications.

There are two perspectives (times) that, we have considered under the CORBA to explain component-based mechanism of the platform independency:

1. Development time and
2. Runtime.

From the development perspective, Interface Definition Language (IDL) is key concept that is used in component-based mechanism in order to achieve independence of a software system that was implemented through an implementation technology in respect to another implementation technology. According to General Concept of the Independency (GCoI) model, we have identified key elements:

- Different implementation technologies that conform to the X element on the GCoI model
- Different specification that enables transformation from IT to IDL interface (XZ elements on the GCoI model)
- IDL interface (Z elements on the GCoI model)
- Different compiler that generate code for different implementation technologies from IDL (ZY element on the GCoI model)
- Different implementation technologies that conform to the Y element on the GCoI model
- These elements are shown below on the Figure 4. and on the Table 3.

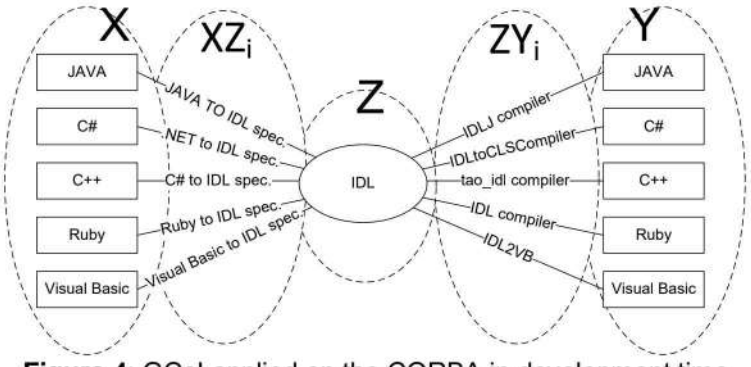


Figure 4: GCoI applied on the CORBA in development time

Table 3. GCoI applied on the CORBA in development time

X	XZ	Z	ZY	Y
Java	JAVA to IDL specification	IDL interface	IDLJ compiler	Java
C#	.NET to IDL specification	IDL interface	IDLtoCLS compiler	C#
C++	C++ to IDL specification	IDL interface	Tao_idl compiler	C++
Ruby	Ruby to IDL specification	IDL interface	IDL compiler	Ruby
Visual Basic	Ruby to IDL specification	IDL interface	IDL2VB	Visual Basic

From runtime perspective, client and server classes, generated by specific ORB programming language compiler, communicates among themselves using ORB vendor classes. ORBs communicate using IIOP protocol that enables software platform independence on both sides (client and server).Therefore the IIOP protocol is the key concept used in order to enable different software components to communicate among each other. According to General Concept of the Independency (GCoI) we have identified key elements:

- Different implementation technologies (Java, C#...) that conform to the X element on the GCoI model
- Different implementation of the CORBA standard (XZ elements on the GCoI model)
- IIOP CORBA that conform to the Z element on the GCoI model
- Different implementation of the CORBA standard (ZY elements on the GCoI model)
- Different implementation technologies (Java, C#...) that conform to the Y element on the GCoI model

These elements are shown on the Figure 5. and Table 4.

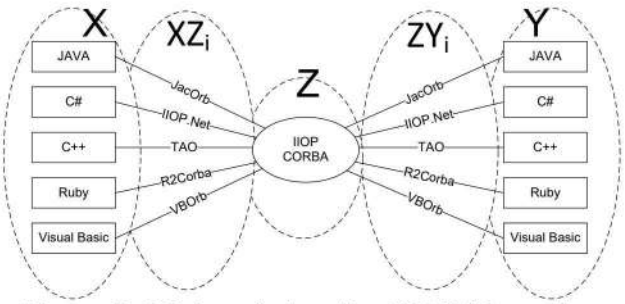


Figure 5. GCoI applied on the CORBA in runtime

Table 4. GCoI applied on the CORBA in runtime

X	XZ	Z	ZY	Y
Java	JacOrb	IIOP CORBA	JacOrb	Java
C#	IIOP.Net		IIOP.Net	C#
C++	TAO		TAO	C++
Ruby	R2Corba		R2Corba	Ruby
Visual Basic	VBOrb		VBOrb	Visual Basic

Model-based mechanism is used in achieving the independence of software architecture in respect to software platform. This mechanism is implemented under Model-Driven Architecture approach.

The concept of Model Driven Architecture (MDA) is published by OMG. It is based on creation of models and transformations between them. OMG describes different type of models and their relations but it does not specify how to create these models and which exact models and notations to use for their representation and how to transform them with one another. The top three models are created as graphical models while the last one as implementation code model.

Computation Independent Model (CIM) - CIM is a model that does not display details of IS construction but it specifies activities that are being processed in the IS. It represents business processes of the organization for which the IS will be developed. (Kardos, 2010)

Platform Independent Model (PIM) – PIM is a model, which describes IS, but hides details in usage of concrete technology. The PIM describes the behavior and the structure of the system. It does not specify operating system, programming language and hardware. PIM models are used to model the functionality and structure of the information system independently of the technological details of the platform, upon which it will be implemented.

Platform Specific Model (PSM) – PSM connects specification from PIM with details that specify what type of platform IS. will use. The PSM is responsible to specify the technical details to implement the PIM, e.g. the operating system, the programming language.

Implementation model (IM) – IM presents platform specific code. This model is usually generated from PSM but also it can be generated from PIM. It represents the deployable code that could be directly compiled and deployed without human interaction.

According to GCoI model, we have identified key elements the can be found in MDA. These elements are presented in Table 5.

Table 5 GCoI applied on the MDA

X - CIM	XZ - CIM-PIM	Z - PIM	ZY - PIM-PSM	Y - PSM
UML activity diagram	Query/View/ Transformation DSL	UML use case	UML Profile Query/View/Transformation DSL GPL	JavaEE
Business Process Model		UML activity diagram		
Data Flow Diagram		UML activity diagram		.Net
		UML use case diagram		
		UML sequence diagram		ORM
		UML class diagram		

PIM in MDA presents element used to achieve independence software architecture in respect to software platform. Different transformation from CIM to PIM can be written in DSL as well as transformation from PIM to CIM.

Virtual machine-based mechanism is used in achieving the independence of the software system, which was implemented through implementation technology in respect to the operating system on which the software system executes. The Fig.13 presents this mechanism.
This type of mechanism is slightly different from other types of mechanisms for achieving platform independence, because it is not directly related to a software system or software architecture, but indirectly through the implementation technology that is used for implementation of the software system. As mentioned earlier in this paper, implementation technologies and operating systems are different types of software platforms. Virtual machine-based mechanism enables independence of implementation technologies in respect to operating system. This mechanism is crucial mechanism because, in combination with other types of mechanisms, that enables independence for different software architectures, it enables independence related to different operating systems, and by that to different hardware platforms.

Virtual machines are used in a number of sub disciplines ranging from operating systems to programming languages and processor architectures. By freeing developers and users from traditional interface and resource constraints, VMs enhance software interoperability, system impregnability, and platform versatility. Despite their incredible complexity, computer systems exist and continue to evolve because they are designed as hierarchies with well-defined interfaces that separate levels of abstraction. The simplifying abstractions hide lower-level implementation details, thereby reducing the complexity of the design process.
Java and .NET are technologies and software platforms that both have the mechanism that realizes platform independence of software systems/applications in respect to a hardware platform and operating system. Java and .NET have a very similar approach to the implementation of the platform independence.
Java virtual machine is a virtual processor "a virtual CPU" that allows the same software to run on the multiple platforms, because software itself does not work directly on the operating system, but works through the Java virtual machine. Java applications can work on all platforms for which Java Virtual machine (JVM) exists.
Furthermore, the goal of Microsoft in the .NET development is to provide independence of .NET applications from the hardware platforms and operating systems. During compilation of .NET source code, compilers, instead of machine code produce common intermediate language (Common Intermediate Language) instructions. These instructions are translated into machine instructions or processor instructions on the machine where the application executes.
According to GCoI model, we have identified key elements:

- Different implementation technologies that conform to the X element on the GCoI model
- Different compilers that compile source code to bytecode or CLI (XZ elements on the GCoI model)
- Bytecode or CLI (Z elements on the GCoI model)
- Different interpreter which interpret compiled source code to concrete operating system (ZY element on the GCoI model)
- Different operating systems that conform to the Y element on the GCoI model

Table 6. presents the key elements of the GCoI model for Java and .Net technologies.

Table 6. Virtual machine-based mechanism applied on the Java and C#

X	XZ	Z	ZY	Y
Java	javac	Bytecode	JVM	Windows, Solaris, Linux
C#	csc	CLI	CLR	Windows 2000,Windows XP, Windows 7

The similar mechanism is identified for programming languages such as Jython, Scala, Boo and IronPython. Table 7. presents the key elements of the GCoI model applied to these programming languages.

Table 7. Virtual machine-based mechanism applied on the other programming languages

X	XZ	Z	ZY	Y
Jython	jythonc	Bytecode	JVM	Windows, Linux
Scala	scalac	Bytecode		Windows, Linux
IronPython	pyc	CLI	CLR	Windows, Linux
Boo	booc	CLI		Windows XP, Windows 7.

Table 8 shows the relationship between types of platform independence and mechanisms of its realization. Columns PI11 to PI3 indicate which type of platform independence is achieved, and rows R1 to R4 refer to a type of mechanisms used in realization.

Table 8. Relation between platform independence types and realization mechanisms

▼ *REALIZATION MECHANISMS* ▼	*PLATFORM INDEPENDENCE TYPES*				
	PI11	*PI12*	*PI13*	*PI2*	*PI3*
R1 (Services-based mechanism)			•		
R2 (Component-based mechanism)		•			
R3 (Model-based mechanism)			•		
R4(Virtual machines- based mechanism)	•				
R5(Machine language mechanism)					•

5. SUMMARY AND CONCLUSION

There are books and papers in literature related to Java's architectural support for platform independence (McGovern et al. 2003; Gong et al. 2003) as well as Web service platform-independent model (Szyperski, 1999; Alonso, 2004) and Corba platform independent model (Merle et al. 1997; Merle et al. 1996; Wang et

al. 2000). Although these papers describe platform-independent model, we could not found papers that analyze all these models of platform independence integrally.

There is no research in literature that analyzes the various mechanisms for achieving platform independence in this way, so we can say that this is the first study of this kind with the goal to not only analyze and compare the ways of achieving platform independence, but to define the general rule that enables it.

The key contribution of this paper is the introduction of the GCoI model, and identification and explanation of different mechanisms for the platform independency realization. The GCoI model represents the fundamental concept that lies behind the platform independence.

This model has multiple significances. While developing new platform or software architecture, engineers should be aware of all necessary elements that need to exist in order to achieve platform independency. In the era of cloud computing, and smart devices, the need for this kind of solutions and "adapter" mechanisms arises, and GCoI model represents the general principle for creating them.

Our practical experience, as university teachers, proved the value of this model when teaching relationships between any new software architecture and platform. When students know the elements of GCoI model, and the concept of platform independency, they can understand it much easier and faster.

REFERENCES

Alonso, G., Casati, F., Kuno, H. and Machiraju, V. (2004), *Web Services: Concepts, Architecture and Applications*. Springer

Bass, L., Clements, P., Kazman, R. (2003), *Software Architecture in Practice* (Second Edition). Addison-Wesley

Buschmann, F. (1996), Pattern-Oriented Software Architecture: A System of Patterns. *John Wiley & Sons*

Christopher, A., Ishikawa, S., Silverstein, M., Jacobson, M., Fiksdahl-King, I., Angel, S. (1977) A Pattern Language. *Oxford University Press*, New York

Erl, T. (2005), Service-Oriented Architecture – Concepts, Technology, and Design. *Pearson Education, Inc.*

Gong, L., Ellison, G. and Dageforde, M. (2003) *Inside Java™ 2 Platform Security: Architecture, API Design, and Implementation*. Addison Wesley

Gorton, I. (2011), *Essential Software Architecture* (2nd Edition), Springer

Gorton, I. (2011), *Essential Software Architecture* (2nd Edition), Springer

Jonathan, L., Shang-Pin, M., Ying-Yan, L., Shin-Jie, L., Yao-Chiang, W. (2008), Dynamic Service Composition: a Discovery-Based Approach. *International Journal of Software Engineering and Knowledge Engineering*, 199-222

Kardos, M. (2010), Analytical method of CIM to PIM transformation in Model Driven Architecture (MDA). *Journal of Information and Organizational Sciences*; Vol 34, No 1.

Liu, Y., Liang, X., Xu, L., Staples M., and Zhu L. (2011), Composing enterprise mashup components and services using architecture integration patterns. *Journal of Systems and Software*, Elsevier, Vol. 84, No. 9, 1436-1446

McGovern, J., Tyagi, S., Stevens, M., Mathew, S. (2003), *Java Web Services Architecture.* Addison Wesley

Meghan, K., Model Driven Architecture Straight From The Masters, *The MDA Journal*

Merle, P., Gransart, C. and Geib. J.M. (1996) CorbaWeb: A Generic Object Navigator. *Proceedings of the Fifth International World-Wide Web Conference*

Merle, P., Gransart, C., Geib, J.M. (1997) Generic tools: a new way to use Corba. *In European Conference on Object-Oriented Programming, Workshop on CORBA: Implementation, Use, and Evaluation*

Object Management Group (2003), Ontology Definition Metamodel Request For Proposal OMG Document: ad/2003-03-40

Szyperski, C., *Component Software: Beyond Object-Oriented Programming*. Addison- Wesley, New York

Vitvar, T., Mocan, A., Kerrigan, M., Zaremba, M., Maciej, M., Moran, M., Cimpian, E. (2007). Semantically-enabled service oriented architecture: concepts, technology and application. *Service Oriented Computing and Applications*, *1*(2), 129-154. Springer

Wang, N., Schmidt, D. C. and Levine, D. (2000) Optimizing the CORBA Component Model for High-performance and Real-time Applications. *ACM/IFIP*

DEVELOPING ANDROID APPLICATION FOR LEARNING DATABASE DESIGN

Dr Saša D. Lazarević[1], Igor Stanišić*[2]
[1]Faculty of organizational sciences, University at Belgrade
[2]City Administration of the City of the Belgrade
*Corresponding author, e-mail: igor.p.stanisic@gmail.com

Abstract: *Period when mobile phones were just devices used for voice and text communication are far behind us. Thus we must to consider option to use them with different approach where they will be accepted as main source to find, discover and learn. We find basis of this idea in mobile applications which - versatile and acceptable, can bring focus to new way of studies which will then transform user's habits and give them alternative for learning. Respecting the results of previous research in the field of using mobile phones for the purpose of education, as well as habits of modern generation of students, we created the educational student application whose content complements the lectures and, if necessary, consultations. This application represents a solution for students of naturally humanities faculties which was, for the first time, in contact with software for databases. The application is based on the respective subjects which are responsible for the further understanding of study programs.*

Keywords*: Android, application, education, studies*

1. INTRODUCTION

While generation X use internet as product which slowly show in their lives creating enough space to learn and get new experience, in the next generation Y it become part of their life making them more informational educated. The period of the latest generation Z is in the progress, but we can predict that diversity in making new knowledge and experience will be bolder and cause can be internet itself – for those generations internet is product that just "exists" (Bogdanović, 2012.). From that point of view, from any new student's generation we can expect to be more and more in connection with internet and new technology, which basically lead to high end devices such as mobile phones. With that information on mind, academic society must find better respond in seek for knowledge for new generations – mobile phones can be used as tube (or channel) which will provide accurate information's to anyone on any place at any time (Milutinović, 2014.). So, if we percept application as tool for learning, we accept future of high education (as well as undergraduate or mid school learning). Of course, any educational app can't be accepting as one and only knowledge source. Instead of be self-enough, those digital learning tools must coexist with formal sources and that compound will provide unique, modern, faster, quality and more dynamic presentation of information's that represents subject of study (Bogdanovic, 2014.). Besides that, we have two additional benefits: first, classes wouldn't be crated only with instructor knowledge and creativity, and second – it will represent domestic educational system with high range of availability to modify content to meet new standards (Pasek K.H, 2015).

2. VERBAL MODEL

Logic that lay in root of the application represent practical product which will connect technical solutions with conventional information's sources. Thus, application must be simple and logically oriented for use, with main concept that will represent standards of Android operating system which users of the platform already known with integrated organization well known in books and educational literature which students use on every day basis: get correct answer fast and in clear way at the same time. Additional functionality will be created with option to take personal notes. Last but not least, application need to use less battery power (Chen, 2015, Flinn, 1999, Morley, 2015.). With all this in mind, we create map of the application where main content is away from user with maximum two clicks. Possibility to create notes is structure which is separated from others and user need just one click to use it (Figure 1). Please keep in mind that diagram shows few activities with the same name, but that is not mistake: content of fields is different.

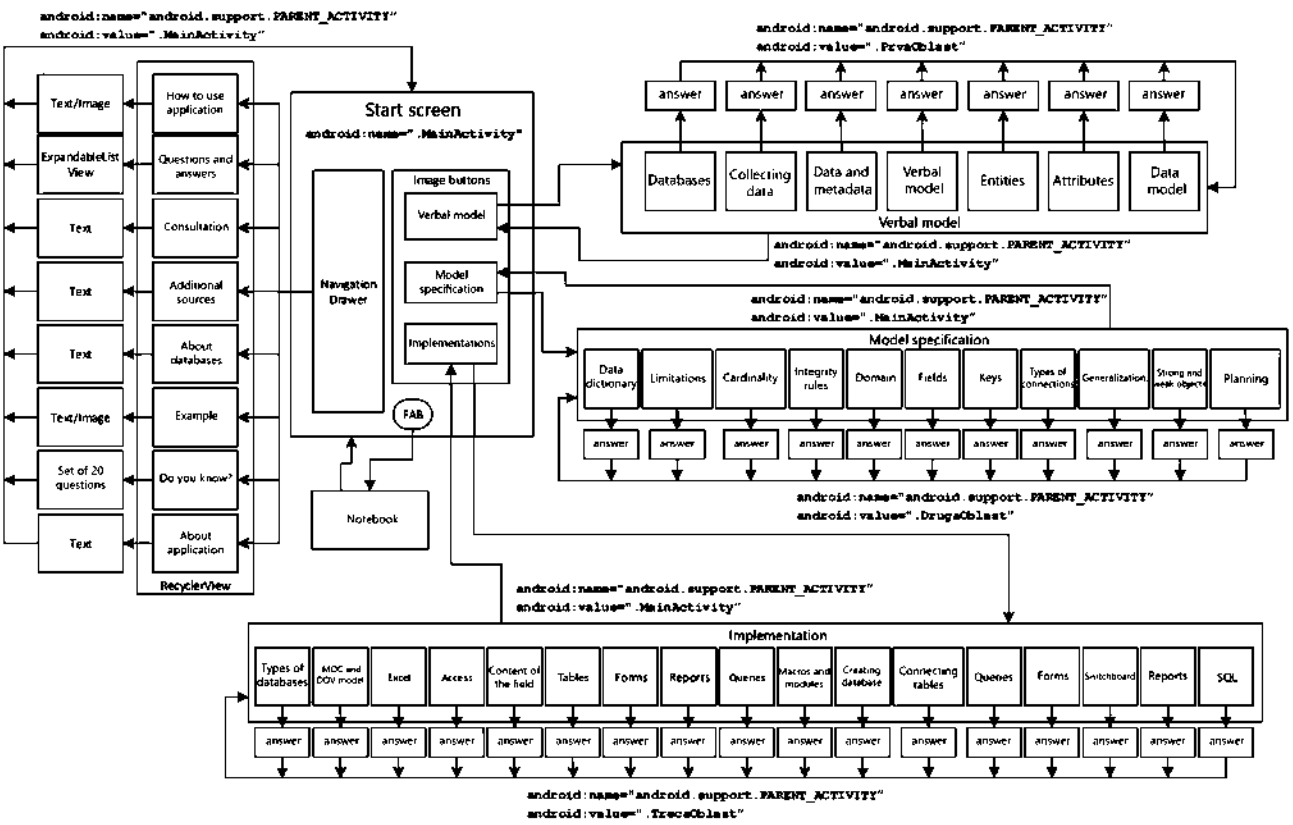


Figure 1: Diagram of the application based on verbal model

Start screen consolidate three application segments: main content which is split into three areas and which represent central part of the display, note taking part which open with click on the button at the lower right corner and additional menu position at the left top corner represented with "hamburger" icon (Figure 2).

Figure 2: example of the main application screen

At the top of any page lay unification App bar.

Main content has three areas:
1) verbal model – contains question and answers about actions which applied prior to planning and implementation, and explains what are entities, attributes, how and why the data are collected and more.

2) model specification – allows users to find explanations of all basic factors that are necessary to create a database such as aggregation, constraints, data dictionary...

3) implementation – the third area define the practical application of the previous steps, explaining database creating software as well as connections, query's, report generation, etc. Also, students have practically described processes step by step.

Content doesn't need to be used by any fixed order. User can open, read and use part of application that is important for him in the moment. Keeping that in mind, simplicity and usability of the application is created in less than three clicks: from main category, user choose question which lead them to the answer and vice versa. So, first choose is category and the second one is the question. All answer contain text and (if there is appropriate) picture (Figure 3).

Figure 3: navigation through application. Main content is only two quests away

Part of the application which provide possibility to take notes lay behind circle Floating Button in bottom right corner of the main screen. Blank field provide user a space to create important information's which later he could copy or modify. Once entered, content stay available as note even after application is close or the phone is rebooted.

Finally, slide menu on the left side of the main application screen contain additional information's such as: how to use application, frequently asked questions, further resources, about databases, example, test and about application.

2.1 CHOOSE RIGHT ARCHITECTURE, TECHNOLOGY AND TOOLS

First step was to define right architecture, technology and tools which will be used during creating application with main purpose to satisfy concept standards. Keeping that in mind, core architecture was Linux kernel with Dalvik virtual machine (or Android runtime – ART) and program languages Extensible Markup Language (xml) and java (Ward, 2014.). Objective API's (Application program interface) in java language determine specific class which ask to implement accompaniment library for objects of that class type can be held by adequate methods. Lower API limit is 15, which means that any device with operating system 4.0.3 or newer can run the application. One of the special requests was Material design which natively run on systems version 5.0 and newer which set up the task to modify xml and java files to cover older Android versions (Annuzzi, 2014.). At the end, the tool which used was Android Studio with support and additional API 23 library's (Jackson, 2014.).

3. MODEL SPECIFICATION

First contact of students from humanity and social sciences with software used to create databases such as Excel, Access or MS SQL Server can be very complex and represent issue for normal learning and afterward using at work. Reason lay in specific logic of work and using programming languages and operations which are usually strange to those students that they didn't use earlier. Therefore, it is necessary for the purposes of understanding the basic definitions and architecture procedure, technology and applied tools, to prepare a unified solution in the form of applications that can provide answers in these areas represent them verbally and graphically.

3.1 OBJECTS-CONNECTION DIAGRAM AND THE DATA DICTIONARY

The application basically has a very simple structure, which is one characteristic that is set as a condition in its drafting – function before form. From the above we see that the home screen aggregation main categories, notebook and side menu (Figure 4).

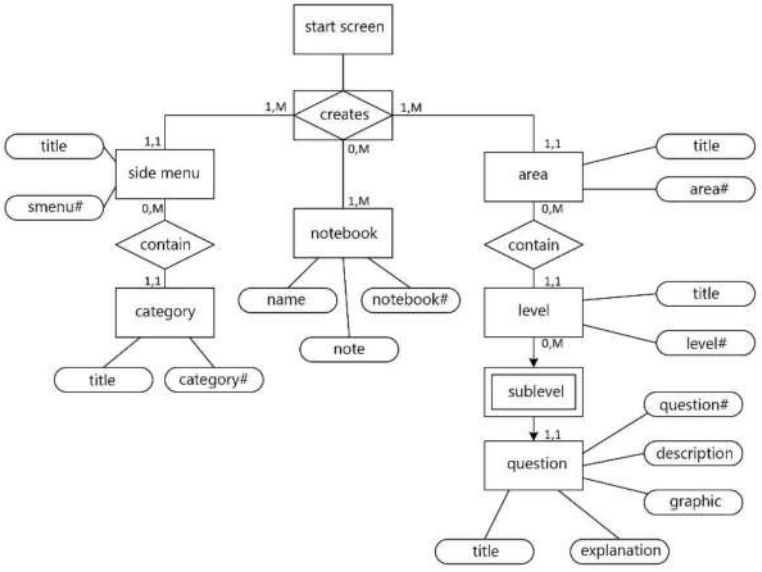


Figure 4: Diagram chart objects - connections for Android app

Start screen can contain one or more side menus, while a side menu can be found in only one home screen. Time this menu can be expanded if necessary by adding new content. Side menu does not have to but it can contain a number of different categories. On the other side, a category may belong to only one side menu. One initial screen doesn't need to contain but can have multiple notebooks and one notebook can be on one or more screens. Since the notebook represent additional functionality that is not a high priority in this case it's cardinality indicates that the same notebook can be accessed from other screens (such as the level of some areas) which isn't obligation. Finally, the area doesn't not need to have a single level, which practically makes possible to adapt the application to a new study program at any moment. Last one, each level (list of issues) should have area to which it belongs.

When we talk about the list of questions (layers), they must have at least one query (defined by entity "question"), and one question must belong to one level. Open condition of the connection between the entities "area" and "level" is defined with cardinality 0, M which giving us freedom of adapting content to other study programs and departments.

Diagram also characterized a simple data dictionary with a mere value-limits (Table 1). Answer, which represent the core of application can't be empty, so we're talking about a very elemental restriction imposed by the requirement that said the field can't be empty.

Table 1: data dictionary for Android application

			simple value limit
	attribute name	**attribute type**	**attribute category**
TABLE AREA			
attribute	NAME	CHAR (40)	IN (VERBAL MODEL, MODEL SPECIFICATION, IMPLEMENTATION)
TABLE LEVEL			
attribute	NAME	CHAR (40)	
TABLE QUESTION			
attribute	TITLE	CHAR (30)	not null
	EXPLANATION	CHAR (300)	not null
	GRAPHIC		
	DESCRIPTION	CHAR (1000)	not null
TABLE NOTEBOOK			
attribute	NAME	CHAR (40)	
	REMARK	CHAR (1000)	
TABLE SIDE MENU			
attribute	NAME	CHAR (40)	
TABLE CATEGORY			
attribute	NAME	CHAR (40)	not null

4. IMPLEMENTATION

Application does not become popular by chance – it is the result of the right decisions made at the right time. It is important to understand the role of performance, quality and robustness that must be respected in the broad market of different devices, considering that the same application can behave completely differently in the two models even if they are both on the same version of the operating system and with the same hardware specification. This is the result of platform fragmentation, as well as free modification of Android OS which is often used by device manufacturer that created them in all shapes and forms rarely updating the core version of the operating system. Also, other software corrections which can be applied on devices (such as manufacturers and operator's modes) may affect the stability and performance of other applications. Finally, it should be understood that the operating system is also the software such as the application that we want to create.

Creating an application create resources that need to be connect with the data sources. System construction (script) takes all sources (XML and java files) apply appropriate tools (for example, converts java classes in dex format) and then grouping them into a single compressed file, with APK extension. Gradle scripts are used in order for this process to be automated (Lee, 2012.). The most important part for developers is build.gradle (Module:app), which sets the lowest value of Android system on which the application can be installed, and to determinate and import the dependent libraries such as RecyclerView or FloatingActionButton.

4.1 THE LOGIC OF CREATED ENVIRONMENTS AND FORMING ELEMENTS

It has already been stated that the minimum requirement to install application is API version 15 or higher. This means that it is necessary to adjust the Material Design environment (which is native at KitKat, Lollipop and Marshmallow systems) to systems where they are not provided by default. Of course, functionality of the application isn't put behind design at any point during creation process. Rather, appearance and specific elements (such as the App bar, Floating Action Button, Recycler View) are used in a way to provide the content on the most functional way closer to user.

The first step in creating and customizing functionality of the new application environment was the adaptation of the Toolbar into an App bar (formerly the Action bar) in the way to hold additional functionality (Phillips, 2013.). In order to achieve a new look and functionality desired, it was necessary to couple the steps of:

1) it is necessary to prevent the system to display a predefined bar with selecting specific theme: basic theme of the application (which is located in styles.xml) need to be changed in the parent value which will invoke the theme without the Action bar:

<style name="AppTheme" parent="Theme.AppCompat.NoActionBar">

At the moment, the activity will show a window without Action bar.

2) define the xml file containing Toolbar: under resources> layout it is necessary to create a new XML file that we will call app_bar while Toolbar define as RootElement. After Android Studio (AS) creates the desired xml file, it will be marked as a Toolbar widget which we don't want. That is the reason why we will instead enter predefined: android.support.v7.widget.Toolbar. Another important step is the change of the content presentation, so instead of "match_parent," the android: layout_height should call "wrap_content".

3) in the layout xml file you need to add <include>: in xml file activity in which we want to show a new Toolbar you need to enter the following code:
<include
android: id = "@ + id / app_bar"
layout = "@ layout / app_bar "/>
This step must be repeated within each newly created activity because the AS will apply the theme that we selected in Step 1.

4) Toolbar initialization using findViewById within the Activity class and use setSupportActionBar () in the Toolbar: in the context of java class activity in which is projected a new Toolbar, first we define a variable private Toolbar toolbar (while respecting that it is android.support.v7.widget.Toolbar) and then in the method onCreate we bring the following:
toolbar=(Toolbar) findViewById(R.id.app_bar);
setSupportActionBar(toolbar); (This command requires that the system does not use the system defined toolbar)

When creating a variable, AS automatically creates a menu item under onOptionsItemSelected that appears in the right corner of the Toolbar in the form of three vertical points (menu). While we don't want this to show up in our application, we completely remove this method from the code.

5) adjustment of various properties of the Toolbar using the Toolbar object or through getSupportActionBar (): opening another activity that also initiated a new Toolbar, the title of the chapter will appear in the header (defined by string and AndroidManifest files) but the button which allows back to previous, parent (parent), activity will miss. Therefore, in the new java class activities under the onCreate method we need to add the following (just below setSupportActionBar (toolbar)):
getSupportActionBar().setDisplayShowHomeEnabled(true);
getSupportActionBar().setHomeButtonEnabled(true);
getSupportActionBar().setDisplayHomeAsUpEnabled(true);
Last method – setDisplayHomeAsUpEnabled (true) must have a boolean value of "true" to return the user to one level instead of at the beginning (start screen) of the application.

AppBar usually contains navigation icon ("hamburger" menu) in the top left corner, the name of the application and a filter option (if there is multiple hierarchical levels), action icons (for access to certain features of the application) and the menu icon in the upper right corner. We decide to look for more simple, cleaner look (Figure 5).

Figure 5: appearance of the native AppBar menu (left) and AppBar menu in our application (right)

4.2 LAYERS AND FUNCTIONS

Most part of user interface was created using ListView containers in RelativeLayout plan, while TableLayout was implemented in several activities. Specific solutions include Navigation Drawer fragment, Recycler View, List View Expandable and Floating Action Button.

For side navigation we chose Navigation Drawer Fragment (NDF) located on the left edge of the screen that will appear only on user request over the home screen (activities), and will represent additional informations. For NDF to be implemented, it is necessary to modify the XML and java file activity in which will be located. The first step represents use of DrawerLayout which contains two items (child) with the corresponding IDs: FrameLayout which hold the main content and NavigationDrawer, while the root XML file activity instead of LinearLayout became android.support.v4.widget.DrawerLayout. Xmlns attributes are transferred to DrawerLayout which then became holder of the LinearLayout who's actually FrameLayout with main content. Adding NavigationDrawer's is done by creating a new fragment (Java and XML files) which is initiates in the XML file of the main activity within DrawerLayout and below LinearLayout. The width of the fragment is 280dp while using android: layout_gravity = "start" we defined a fragment to be on the left side of the main screen until user action. We want to system recognize that fragment so in the last line we entered location of the created xml file. To use NDF, it is necessary to call methods within main activities Java class in order to bypass Toolbar, which is created under the Java class Navigation Drawer Fragment. It is necessary to apply the constructor ActionBarDrawerToggle that implements class DrawerLayout.DrawerListener. In other words, in this way the NDF, Toolbar and layout activities will be linked into one which, in practice, mean that when user select an icon in the toolbar it will open NDF (Lee, 2013.).

If we run the application at this point, we will have transparent fragment covering the main activity while in the Toolbar will be "hamburger" menu. Therefore, it is necessary to adjust the value of the background color in xml file fragment, while the java class NavigationDrawerFragement must have method: mDrawerToggle.syncState ().

With this step we have created the NDF, which is empty and respond to the user's reference. In the next step we need to input content.

4.3 RECYCLER VIEW (RV)

Recycler View is not a substitute for the List View. It is far more advanced solution which use Layout Manager and allows us to view content at a much more dynamic way than the List View can provide (Jackson, 2014.). The architecture shown in Figure 6 explains the work of RV. Data Model is a menu item. Adapter draws each menu item and trying to display them with a View holder who is the xml layout for each menu item, which is incorporated into the java code. View holder decides whether the item will be

permanently displayed or not. Recycler View will use View holder to display each menu item. On the other hand, the Layout Manager determines how the content will be displayed (as a list of fixed width, in parallel columns or as a group of cards in different sizes). Item Animator is responsible, as its name suggests, to animate Recycler View such as removing items from a list, move them in the order, etc. Item Decorator allows items to be grouped into different sections according to their content. RV represents a flexible solution for viewing large amounts of data on a limited area of the screen. Since the creation of content composed of images and text represent complex and demanding task for application (each line requires the creation of an independent xml file that must be inserted in the code via the Layout inflator as well as finding items by using the TextView, ImageView and the related controls findViewById) calling (inflate) the item only when recycled and which is already found represents a significant beneficial solution. The point is to avoid use of the View Holder object or method findViewById every time you want to display a longer list of items on display but

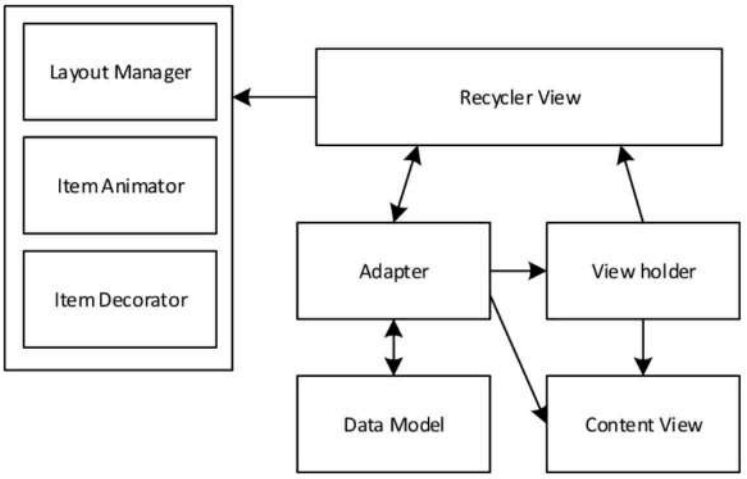


Figure 6: construction of the Recycler View

rather to allow the first item from the list to be cashed and appears only when it is needed. In fact, the limited area of the screen that is able to show, for example 5 items, when we move through the menu to display the paragraph 6, paragraph 1 shall be removed from the list. It will then move to recycler status and wait to be invited again.

The first step of the implementation is compiling a support library in Gradle script for recyclerview v7 widget while next represents its implementation in NDF xml file. It is important to enter the code below Linear (or Relative) Layout in which is placed an image that is part of the NDF. When rendering in Android Studio, review will not show any content. The reason for this is that unlike the List View, content must be initialized in Java code in the Layout Manager since it is not fixed. Before that, it is necessary in NDF java class to define Recycler View which is achieved by the following code:

recyclerView= (RecyclerView) layout.findViewById(R.id.drawer_list);

In this code, R.id.drawer_list represent id which we assigned to RV in xml file.

To populate the menu list, it is necessary to create a new java class (which we'll call Information) in which will be defined integer for the icon, and string value for the name. This data will provide adapter that represents a new java class that extends RecyclerView.Adapter which owns argument <VH> or ViewHolder which means that the latter is expected to have another class that extends a ViewHolder to represent argument. View Holder is there to describe the appearance of the item and its place in the RV and that the source, once found, automatically draws and displays in the required order. Therefore, in the construction we use parent class ViewGroup and viewType. In order for content to be developed, it is necessary to create a new xml file which will represent the appearance of a row, whose content will define the ImageView and TextView. Data from the newly created file are referenced in the java class adapters to allow the ViewHolder data calls and shows itself without the need for constant creation. Contents will be displayed by entering a few lines of code and linking with the previously created files. First you must enter the following classes in the java file adapter:

List<Information> data = Collections.emptyList();

and then in onBindViewHolder:

Information current = data.get(position);

```
holder.title.setText(current.title);
holder.icon.setImageResource(current.iconId);
```

Displaying the contents is calls by the NDF java file, creating methods:

```
public static List<Information> getData(){
List<Information> data=new ArrayList<>();
int[]icons={R.drawable.ic_lightbulb_grey600_24dp};
String[]titles={"Kako koristiti aplikaciju"};
for (int i=0; i<titles.length && i<icons.length;i++)
{
Information current=new Information();
current.iconId=icons[i];
current.title=titles[i];
data.add(current);
}
return data;}
```

Adapter initialization that displays content is created under onCreateView.

We want to connect content of RV with new activities which referred to, thus in the adapter Java class we need to create OnClickListener and in the NDF Java class method itemClicked. Because the Java class adapter has very little code, it makes it very flexible and opens up the possibility that the same adapter be used for other RV if they call the same information.

By implementing Recycler View in Navigation Drawer Fragment and creating connections with external activities that carry content, we finally fill the side menu and make it available to the user.

4.4 FLOATING ACTION BUTTON (FAB)

Floating key of activities represent the specific solution that characterizes Material environment (Jackson, 2014.). As NDF, this element is not recommended for use if there is no meaningful purpose that is usually reflected in the functionality that need to be quickly available - shortcuts to applications segments, arranging and writing messages, custom content (for copying and pasting content) etc. Therefore, we created FAB at the bottom right corner that leads directly to a notebook activity which characterized up to 100 lines of text input with up to 20 lines to display at the time (as defined in the value of its XML files). All the entered text is stored in the notebook until delete, which means that leaving the application or restart the device does not affect the stored text, which is achieved by entering the created content in SharedPreferences of corresponding java file. Entered text can be marked, copied, cropped and pasted, but because we didn't set any specific requirement when installing, it can't be send directly from the application.

Creating of the FAB can be do manually or using existing library. In our case, we have created a library using existing sources which is why we are in the Gradle script called and compile a dependent library CircularFloatingActionMenu: 1.0.2. Within the java class activity in which the FAB will occur, it must be initializing under the method onCreate and determine the icon that will appear (located in the drawable folder). Button background also is also called from drawable folder and represent an XML file that defines the layout when the key is pressed and in standby mode (lighter and darker background). Since FAB is removed from the screen when the notebook activity is open, this step is not necessary since there is no visual effect. Newly formed FAB must be connected with corresponding XML files, which is why necessary to implement OnClickListener after which it calls creation of tag icon.setTag("fab"); icon.setOnClickListener (this); after which in the onClick method needed to initialize event that will trigger the activity:

```
public void onClick(View v) {
if (v.getTag().equals("fab")){
startActivity(new Intent(this, Beleznica.class));}}
```

When a user clicks on FB on the home screen it will open activity notebooks. User will be return to the home page, which is the parent of this activity, after he done editing.

5. CONCLUSION

This paper presents a simple application for education of students and others who want to learn more about the possibilities of creating a database on their smartphones. Respecting the results of previous research of using mobile phones for the purpose of education and habits of modern generation of students, created the

content that complements the lectures and, where appropriate, consultations. The application is based on the respective subjects who are responsible for the further understanding of the matter that students learn. To avoid any compromise between content and form, the application is designed, created and implemented by respecting and implementing of the Google standardization of Material environment that will make users of newer mobile devices to use it in friendly, easy environment. Most of the time was spent on special modification of code and application structure. The development of application core took about four weeks, gathering materials and implementation additional fifteen days while the extra week spent for removing bugs and code optimization.

REFERENCES:

AMIDuOS, http://www.amiduos.com/, (31.08.2015.)

Annuzzi Jr. J. et al. (2014.) Advanced Android Application Development, Addison-Wesley Professional

Bogdanovic Z et al. (2014.) Evaluation of mobile assessment in a learning management system, British Journal of Educational Technology, vol 45, Issue 2, 231 – 244.

Bogdanović Z., Zrakić M. D et al. (2012.) Providing Adaptivity in Moodle LMS Courses

Chen X. et al. (2015.) Smartphone Background Activities in the Wild: Origin, Energy Drain, and Optimization, Purdue University, Mobile Enerlytics, Intel Corporation

Flinn J., Satyanarayanan M. (1999.) Energy-aware adaptation for mobile applications, 17th ACM Symposium on Operating Systems Principles (SO SP '99), Published as Operating Systems Review, 34(5):48–63

Jackson W (2014.) Android Apps for Absolute Beginners, Apress

Jackson W. (2014.) Pro Android UI, Apress

Lee W.M. (2012.) Beginning Android 4 Application Development, Wrox

Lee W.M. (2013.) Android Application Development Cookbook: 93 Recipes for Building Winning Apps, Wrox

Milutinović M et al (2014.) Ontology-Based Multimodal Language Learning, High Performance and Cloud Computing in Scientific Research and Education, Hershey, PA: IGI Global, DOI:10.4018/978-1-4666-5784-7.ch008, 195-212.

Morley B. D. et al. (2015.) "Dynamic battery saver for a mobile device", United States Patent, US 8,958,854 B1, Feb. 17

Pasek K.H et al. (2015) Putting Education in "Educational" Apps: Lessons from the Science of Learning", Psychological Science in the Public Interest, 2015, Vol. 16(1) 3–34

Phillips B. (2013.) Android Programming: The Big Nerd Ranch Guide, Big Nerd Ranch Guides

Ward B. (2014.) How Linux Works: What Every Superuser Should Know, No Starch Press

COMPARATIVE ANALYSIS OF UML MODELING TOOLS WITH FOCUS ON BUSINESS LOGIC SPECIFICATION

Vojislav S. Stanojević*[1], Saša D. Lazarević[1], Milić Ž.Miloš[1]
Faculty of Organizational Sciences,
*Corresponding author, e-mail: vojkans@fon.bg.ac.rs

Abstract: *Growing need for software products and reduced time for software development are crucial for success of a software project. Therefore, there are lot of approaches for software development in order to reduce time to market. One of the most popular is Model Driven Development. Main goals are to narrow the gap between all stakeholders in software development process and to decrease time from requirements specification to final version of software. There are lot of tools that supports UML modelling and MDD approach in order to shorten software development process. Using case study we will analyse three selected tools (Enterprise Architect, Visual Paradigm and Papyrus) in order to determine which one is best suited for MDD. For that purpose we will determine criteria for comparison and give a summary.*

Keywords*: MDD, business logic, UML, models, code generation, UML tools*

1. INTRODUCTION

If we look at economic development in recent years, even decades, the obvious conclusion is that the information systems and technologies are one of the most dynamic industries, where a lot of resources are invested. In such an environment, continuous development and progress are necessary.

In step with the progress of technologies, market requirements have become more sophisticated. The critical factor is response time needed to meet those requirements. High-quality of system architecture assures achieving this. The software architecture must support the complex requirements, frequent changes and quick response to those changes.

The aim of this research is reducing development time, and more importantly reduce response time to the frequent changes required by the client. In addition, it is preferable to avoid repetitive tasks and processes, and make them to be executed automatically. Model driven development is approach that reduces response time, complexity of requriements, business processes modellling and implementation at the end. Approach that will be used in this research is to use model as basic component and set of business rules defined for that model.This reserach should give an answer regarding possibilites of automatic code generation for elements of business logic using specific tools. For this purpose we will conduct case study survey analysing tools supporting UML models and code generation. For this purpose we selected Enterpise Architect, Visual Paradigm and Papyrus (plug-in for Eclipse) .
We will first give a short introduction to MDD, UML and OCL. Afterwards we will determine place and role of business logic in a software system and then present results from tool analysis and then give final conclusion.

2. MODEL DRIVEN DEVELOPMENT - MDD

Start of a software project can be very difficult. The path from requirements elicitation to software product is long and there is a problem with requirements validation. Often mistakes made in requirements gathering and specification are identified in late stages of software development which can have great impact on software success. One of approaches that tried to narrow the gap is Model Driven Development (MDD). Main idea in MDD is that there is no model which will be thrown away. One of key features is model transformation. This is very important because there are lot of interested parties which has different levels of technical knowledge. For instance on one side there are persons like sponsors and domain experts, with poor technical knowledge, and on the other side there are software engineers (architects, software, testers...). All of them are interested in software development from their point of view. Therefore there is a need for different type of models, but essential thing is to keep those models in tune with each other. This is not always easy but there are lot of software tools which offer help in model synchronization and their use throughout software development. Language which is widely used for purpose of software modelling is UML. Very important concept in MDD is model to model transformation. Final model is usually programme code and that is most important concept for software development.

3. UML LANGUAGE

Unified Modelling Language (UML) is language and a standard for software modelling and design. Besides structural and behaviour models UML defines models for business process modelling [5]. It is widely used in object-oriented software development methods. There different models that are used in different development phases. The main idea behind all models is to keep them simple as possible in order to make them understandable for large variety of stakeholders.

UML advantages:

- Is a standard for software development
- There is a lot of tools that supports UML models
- Shortens software development
- UML models overcame software engineers problems (Schmidt, 2006)

From our point of view most interesting models for the paper are:

- Structural models: Class diagram
- Behavioural models: Use case diagrams, State diagrams, Sequence diagrams

UML supporting tools enable model integration and model transformation, which is of big interest for this paper. For purpose of this paper it is very important to mention Object Constraint Language (OCL) and it use and integration with UML models.

4. OBJECT CONSTRAINT LANGUAGE - OCL

Object Constraint Language, widely known as OCL, is semi-formal language for describing constraints of object-oriented models (F. Barbier et al., 2001). It is very important addition to UML language and it can be considered as integral part of UML. Formal languages require big knowledge of math, which business analyst and modellers usually do not have. OCL is less formal and it is easier to write and read. It is not directly executable.

```
context Person::getCurrentSpouse():
   Person
pre:   isMarried = true
body:  mariages->select
       ( m | m.ended = false ).spouse
```

5. BUSINESS LOGIC AS PART OF SOFTWARE SYSTEM

The focus of our work is business database applications. Most of software systems of this kind have multi-tier architecture and most common one is three-tier software architecture. Larman identifies these tiers as **User interface**, **application logic** and **data storage** (Larman, 2004).

Figure 1: Three tier software system architecture

Furthermore, application logic has three logical parts: **Application logic controller**, **Business logic** (Domain objects, Services) and **persistence framework**.

In his book Vliet describes that from users point of view user interface represents whole system (H.V.Vliet, 2008). Research showed (B. Myers and M. Rosson, 1992) that 48-51% of time needed for software development goes to user interface. We have already written about models and tools, which we proposed for user interface generation in (Antovic et al. 2012). Business logic development takes around 15% and we think that this is not in accordance with significance that this tier has in software system. This was a sort of alarm because we think that business logic development does not get as much attention as it should.

We will define UML models of great interest for business logic modeling. In order to do that will will look for models used in different stages of software development.

5.1 Business logic in requirements phase

This phase of software development is marked as crucial for success of software project. This paper focuses on use case technique. There are lot of use case definitions and all of them point out interaction between actor and the system (Cockburn, 2000; Vlajic, 2011; R. Schach, 2010; Adolph, 2001; Jacobson et al.1992).

From a business logic perspective, it is very important to consider an action (transaction) types. *Ivar Jacobson* mark off four types of transactions (Jacobson et al.1992). Only one relates to a main actor and Jacobson defines it as User request action. Three remaining actions are relates to the system: System validates request and the data, system changes its internal state and the last one refers to response showed to the actor.

Vlajic gives a little different list of actions (Vlajic, 2011) :

Actor actions:

- Actor prepares input for system operation. (**APISO**)
- Actor calls system to execute system operation. (**ACSO**)
- Actor executes non-system operation. (**ANSO**)

System actions:

- System executes system operation. **(SO)**
- System shows result of system operation execution. **(OutA)**

5.2 Business logic in analysis phase

During the analysis phase, one should describe **logical structure** and **behaviour** of a software system. System sequence diagram and system operation contracts describe behaviour. Conceptual and relational model defines structure of a software system.

The use case specification is a starting point for analysis phase. System sequence diagram is made according to use case, and only two types of actions are shown ACSO and OutA. In order to create

these diagrams one must identify system operations signature. While APISO action describes name and parameters of a system operation, the IA action refers to return value and messages that has to be show to the actor.

Preconditions are conditions that have to be met in order to execute SO. They are highly related to constraints of a domain and relational model. On the other hand **post conditions** are related to conditions expressed through state of a domain object after successful SO execution

5.3 Business logic in design phase

In this stage of software development detailed architecture of software system is given. In the introduction of this paper, we wrote that the area of our research is software systems divided in three logical parts. In this phase of a software development one must take implementation technologies in to the account.

This phase of software development must give answers to questions about system operation execution. For this purpose detailed sequence diagrams for every system operation is made in this phase. In contrast, we believe that it is important to make some kind of technology independent specification. This will provide an open space of possible implementations.

6. UML MODELING TOOLS ANALYSIS USING CASE STUDY

In this section we will give an overview of tools which are marked as important. Chosen tolls are Enterprise Architect, Visual Paradigm and Papyrus plug-in for Eclipse IDE.

We will conduct a survey that will give an answer how well the tools support business logic specification and it transformation to programme code. We marked models that are important for a business logic modelling. In addition to that we should add a decision table which is related to business rule specification. Will examine how decision tables are integrated in code generation process.

During the research we have marked criteria important for analysed tools. The criteria are as follows:

- Visual view and drawing diagram utility
- Complex business rule definition support
- OCL support
- Model - code synchronization

Next we will give an overview of tools analysis. We will compare their features related to the criteria.

We analysed the tools using several use cases. Next use case model diagram created in Visual Paradigm shows all use cases used in tool analysis (figure 2).

Firstly, authors will like to point out glossary option in Visual Paradigm. One has option to define terms and even synonym for it, which can be very useful to end users. Next figure (figure 3) shows terms which are often used in case study.

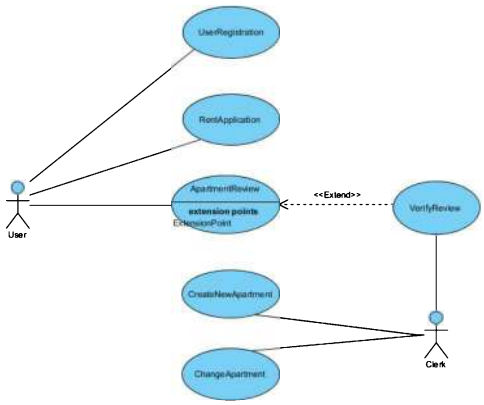


Figure 2: Use case modl diagram - Visual Paradigm

Figure 3: Term definition in Visual Paradigm glossary

The terms from the Glossary are automatically recognized in all UML diagrams. Figure 3 shows Use case definition where are terms recognized. One can see it as underlined word. This is very useful feature. Enterprise architect also enables Use case specification.

Figure 4: Use Case in Visual Paradigm

Diagram that is most often used is class diagram. All of the tools enable visual class diagram modelling. There is slight difference between the tools. It is mostly related to model constraints definition. Figure 5 presents class diagram designed in the tools. It important to address that Papyrus tool enable profiles, so one can choose its own profile instead of default one (for instance JAVA). This will enable JAVA type support for attribute definition and method signature as well.

As one can see models are almost the same and difference is present in OCL constraint support.

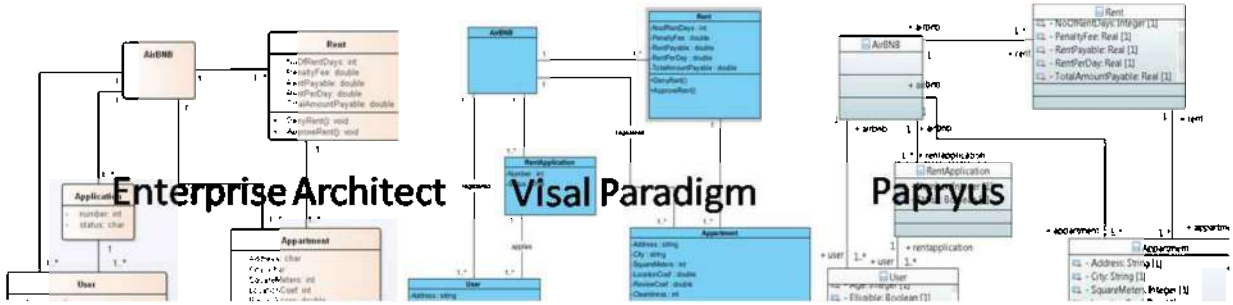


Figure 5. Class diagram in all tools

Papyrus tool has the best OCL integration. It is present in Enterprise Architect as well but with poor integration. Visual Paradigm does not have support for OCL.

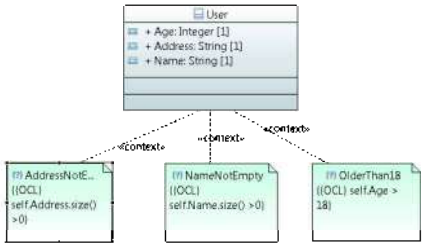


Figure 6: OCL constraints - Papyrus

When it comes to business rule specification it is best supported by Enterprise Architect. It is based on decision tables and in addition it enables code generation. At the first stage user define textual specification for business rules and afterwards one should define rules in specially designed decision table. On the other side Visual Paradigm offers same decision table functionality but authors did not find any code generation feature for it.

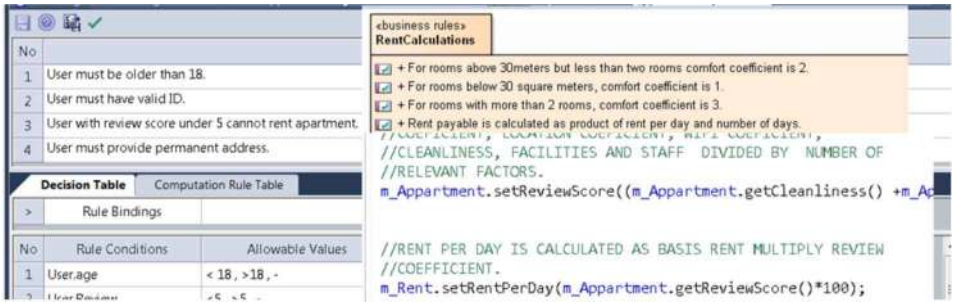


Figure 7. EA decission tables support with generated code

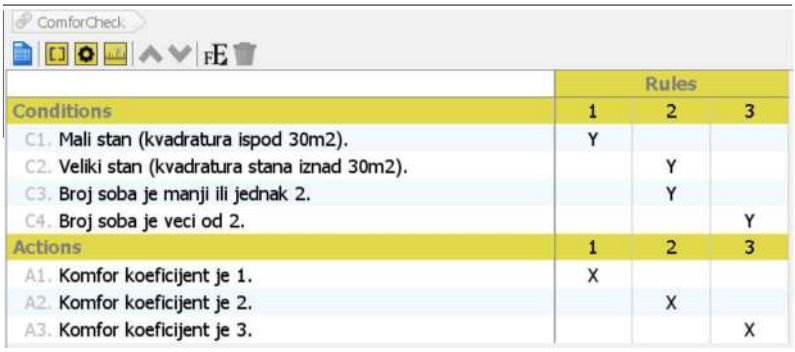


Figure 8: Visual Paradigm decision table

All tools have support for sequence diagram. Visual Paradigm enables transformation from Use Case specification to system sequence and activity diagram. It is very strange that Visual Paradigm does not support transformation from sequence diagram to programme code. It offers only reverse engineering option from code. Other tools supports code generation from sequence diagrams.

Very important feature is model-code synchronization. All tools in certain degree have model-code transformation but it is hard to expect that all features are covered, especially business rule and decision table support. For instance changes detected in Domain class code is reflected in Class diagram in all tools. All the tools support synchronization from programme code to sequence diagram.

We will give short summary for every chosen criterion.

Visual view and drawing diagram utility:

Enterprise Architect *enables modelling of every aspect of software development. It has good performance even when loading big models. Its environment is user friendly models are simply and easy to maintain.* ***Visual Paradigm*** *has very large community which is pushing forward tool development. It has good support for UML diagrams.* ***Papyrus*** *has well designed environment but it is not very easy to use. It does not have automatic align functionality so models can be difficult to read.*

Complex business rules definition:

Enterprise architect is absolute winner by this criterion. It has very well business rule definition system and good code generation utility. **Visual Paradigm** has very poor support for business rule specification. **Papyrus** does not have decision table support as two already mentioned tools but it has best OCL support.

Code generation options:

Enterprise Architect has several models to code transformations. It enables transformation to target programming platform from Class diagram, decision tables and sequence diagram. Visual paradigm

has very poor support for code generation. Only this tool does not support code generation from sequence diagram. Papyrus has most sophisticated support for code generation. It very easy to generate programme code skeleton for chosen target platform. It is also possible to add OCL constraints to UML models and include it in transformation process.

Final results are presented in table 1.

Table 1. Summary results

Criteria	Enterprise Architect	Visual Paradigm	Papyrus
Visual view and drawing diagram utility	4	**5**	3
Complex business rules definition	**5**	3	3
Code generation options	4	3	5
OCL support	2	1	**5**
Model - code synchronization	**5**	**5**	4

7. CONCLUSION

Growing need for software products and reduced time for software development are crucial for success of a software project. Therefore, there are lot of approaches for software development in order to reduce time to market. One of the most popular is Model Driven Development.

From one side MDD narrows the gap between all stakeholders in software development process and from the other side it decrease time from requirements specification to final version of software. Market offers lot of tools that supports UML modelling and MDD approach. For the authors most interesting tools that supports UML modelling are Enterprise Architect, Visual Paradigm and Papyrus.

Firstly we gave introduction to Model Driven Development approach, followed by UML and OCL. Afterwards we have presented place and role of business logic in a software system and then present results from tool analysis and then give final conclusion.

This research gives an answer regarding possibilities of automatic code generation for elements of business logic using specific tools. Using case study survey we have analysed tools supporting UML models and code generation (Enterprise Architect, Visual Paradigm and Papyrus).
We made a conclusion that all tools supports visual UML modelling but the extent of business rule specification and related code generation varies. All in all we made conclusion that all tools have some advantages and disadvantages. Visual efects are best in Visual Paradigm and Enterprise Architect are almost at the same level. When it comes to code generation papyrus is best solution.
Authors will give a slight advantage to **Enterprise Architect** tool.

8. REFERENCES

Douglas C. Schmidt, *Model-Driven Engineering. IEEE Computer*, 39(2), February 2006.

F. Barbier, B. Henderson-Sellers, A. L. Opdahl, and M. Gogolla, *Unified Modeling Language: Systems Analysis, Design and Development Issues, 2001*

Craig Larman, *Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development,* Prentice Hall PTR Upper Saddle River, NJ, USA, ISBN:0131489062, (3rd Edition), 2004

H. V. Vliet, *Software engineering: principles and practice*, John Wiley & Sons Ltd, 3rd edition, Chichester, West Sussex, England, 2008.

B. Myers, M. Rosson, *Survey on user interface programming,* ACM: Human Factors in Computing Systems, Proceedings SIGHI, 1992

Ilija Antovic, Siniša Vlajic, Milos Milić, Dušan Savić, Vojislav Stanojević**,** *Model and software tool for automatic generation of user interface based on use case and data mode*, IET SOFTWARE, (2012), vol. 6 br. 6, str. 559-573

A. Cockburn, *Writing Effective Use Cases*, Addison Wesley Longman Publishing Co. Inc, Boston, 2000

S. Vlajić, *Projektovanje programa (skripta)*, Dr Siniša Vlajić, Beograd, 2011

Stephen R. Schach, *Object-Oriented and Classical Software engineering*, Eight edition, William C Brown Pub**,** 2010

Steve Adolph, Paul Bramble, *Patterns of Effective Use Cases*, Addison -Wesely, ISBN 0-201-72184-8, 2001

I. Jacobson, M., Christerson, P. Johnsson, and G. Overgaard. *Object-Oriented Software Engineering: A Use Case Driven Approach.* Addison-Wesley,Wokingham, England, 1992.

A POSSIBLE APPROACHTOAUTOMATING THE DESIGN OF NoSQL DOCUMENT-ORIENTED DATABASES

Dejan Stojimirović*[1], Siniša Nešković[1], Nina Turajlić[1]
[1] Faculty of organizational sciences, University of Belgrade
*Corresponding author, e-mail: dejan.stojimirovic@fon.bg.ac.rs

Abstract:*Even though NoSQL databases are being used more and more for the development of web applications, there is no systematical approach or methodology for their development. A methodological approachtodocument-oriented NoSQL databases design is laid out. In the presented approach semantically richExtended Entity-Relationship modelsare used as conceptual data models,which are then transformed into concrete document-oriented NoSQL data models through the application of a set of rules. The paper suggests a possible approach to automating this transformation which is in accordance leading approach to software development today – Model-Driven Development (MDD).*

Keywords*:Extended Entity-Relationship model, document-oriented NoSQL databases, database design, transformation rules,automated transformation, model driven development*

1. INTRODUCTION

Nowadays so-called NoSQL (*Not only SQL*) databases are being used more and more for the development of web applications. The popularity of these databases can be attributed to the fact that, on the one hand, they are geared towards rapid and easy manipulation of large volumes of data, while, on the other hand, most existing NoSQL database management systems are open-source, thus the costs of developing web applications when using such systems are much lower. An additional advantage of NoSQL databases, over traditional relational (SQL) databases, is that the data is stored in a far more flexible manner given that they do not presume the existence of a database schema, or more precisely put, they do not require a rigidpre-defined data structure.

Even though a schema structure is not required, there is still a need for knowing how the data is structured in order to be able to manipulate it in the application.In other words, it is necessary to map the data thatis to be stored in the database onto the concepts which are available in the chosen NoSQL database type (e.g. collections, tables, documents, key-value pairs, etc.). The design phase, as is the case with traditional relational databases, should result in a database which enables easy and efficient manipulation of the stored data. Even though NoSQL databases have been in use for a number of years, no precise methodological approach to designing such databases has, thus far, been put forth. Thus, the design of these databases is usually based on the general recommendations of individual NoSQL database vendors.

Apossible methodological approach to designing NoSQLdocument-oriented databasesis presented (*Stojimirović & al, 2015*). It follows the traditional phases of database design (*Simsion& Witt, 2004*): conceptual design (i.e. defining a technology-independent specification of the data that is to be stored), logical design (i.e. translating the conceptual model into a model defined in terms of the structures of a DBMS) and physical design (i.e. the specification of the physical storage, access mechanisms, performance optimization, etc.). Extended Entity-Relationship (EER) models are used as conceptual data models, which are then transformed into concrete document-oriented data models through the application of a set of rules.

However, the manual coding of CRUD (Create, Read, Update and Delete) operations for complex data structures can be very time-consuming and is often prone to errors (even more so in view of the absence of a rigid data structure schema). This paper, expounds on the work presented in (*Stojimirović& al, 2015*)and suggests a possible approach to NoSQL document-oriented database design that is in accordance with the leading approach to software development today – Model-Driven Development (MDD). The main goal of MDD is to enable the automation of software development. In MDD models are primary software artifacts and development is automated through appropriate model transformations. Hence, model transformations are a key component of MDD as they represent a means for the automatic generation of target models from source models, with the ultimate goal of producing a concrete implementation (i.e. executable code) starting

from a conceptual model (i.e. a platform independent model – PIM). Thus, the main goal of the suggested approach to automating the design of NoSQL document-oriented databases is to eliminate the need for manually coding CRUD functionality by automatically generating the data structures and corresponding CRUD operations for a document-oriented NoSQL database, from an EER model.
The paper is organized as follows: Section 2 gives a brief overview of the current state of the art pertaining to this issue. The main concepts of Extended Entity-Relationship models and document-oriented NoSQL databases are presented in Section 3. The proposed methodological approach is outlined in Section 4. Finally, Section 5 concludes the paper and discusses future work.

2. CURRENT STATE OF THE ART

An assessment of the current state of affairs in the field of databases reveals that relational databases are prevalent (*Sadalage& Fowler,2013;Vaish, 2013; Lazarević& al, 2016*).Given that they have been in use for more than 30 years, a good deal of research effort has been dedicated to the issue of their design, resulting in a number of methodologies and approaches with clearly set rules regarding the manner in which a database schema should be designed.

While NoSQL databases do not presume the existence of a database schema, it is still necessary to structure and organize the data in a manner that facilitates its manipulation. Consequently, a number of decisions must be made when designing NoSQL databases, which are influenced, on the one hand, by user requirements, and on the other, by demands related to their scalability, performances and especially their consistency. These issues also aroseformerlywhen it came to the logical design of relational databases or mapping XML (eXtensibleMarkup Language) documents to relational databases (*Sadalage& Fowler,2013*).

The introduction of an abstract NoSQL database model, as an intermediate model between logical concepts and NoSQL database concepts, has been proposed in (*Bugiotti& al, 2013*) with the aim of simplifying the management of data in such databases. This paper presumes the existence of a semantically rich model (i.e. the extended Entity-Relationship model) as a conceptual model.

To the best of our knowledge, as of yet, there is no systematical approach or methodology for developing NoSQL databases. Even though a number of researchers have indicated the need for such an approach (e.g. *Vaish, 2013; Sadalage&Fowler ,2013*) NoSQL database development is currently based on the best practices in this field (*Lazarević& al, 2016; Katsov, 2012; Baker & al, 2011*).

3. OVERVIEW OF THE FUNDAMENTAL CONCEPTS

3.1. Extended Entity-Relationship (EER) model

Entity-Relationship (ER) models (*Chen, 1976*) are semantically rich data models which can be graphically expressed and, as such, are extensively used for database design. The original ER model was later extended in order to incorporate additional (semantically rich) concepts for more accurately modeling complex systems.Ametamodel of the Extended Entity-Relationship model is depicted in Figure 1.

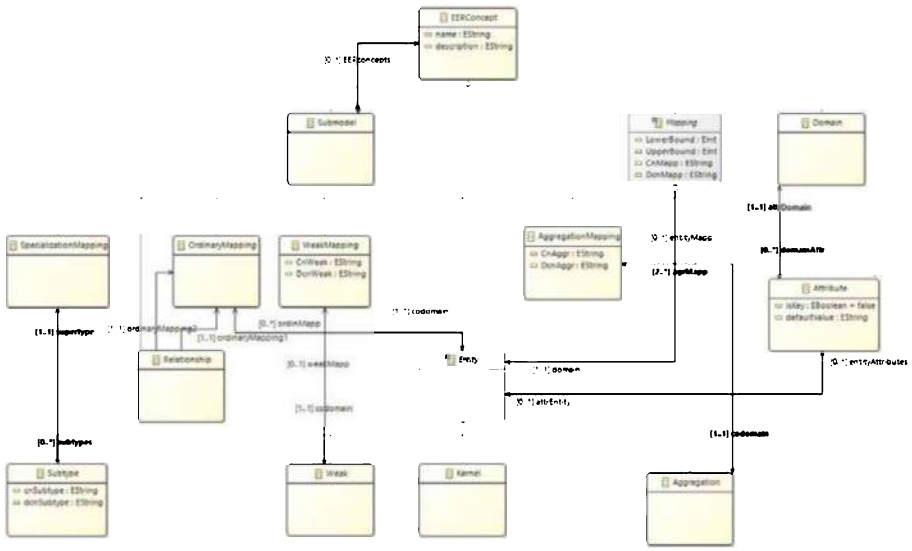


Figure 1: Metamodel of the Extended Entity-Relationship model

The *EERConcept* concept represents the core concept from which all of the other concepts are derived. The *Submodel* concept represents a concrete EER model and is the root element which encloses all of the other concrete model elements. An *Entity* is an abstract concept, representing classes of objects, which is specialized into the *Strong Entity (Kernel)*, *Weak Entity*, *Subtype* and *Aggregation* concepts. An *Aggregation*is a type composed from other entities. A *Weak Entity* is an entity whose existence depends on the existence of another entity, while a *Subtype* represents a specialization of an *Entity*.Entities are described by their *Attributes* which take their values from *Domains*. A *Mapping* represents an abstract mapping(wherein a relationship is specified by two mappings)and is characterized by two attributes: *upper*(maximum) and *lower*(minimum) bounds of the mapping cardinality. The *Mapping* concept is specialized into the *Aggregated Mapping*, *Weak Mapping*, *Specialization* and *Ordinary Mapping*.Each specialized entity is associated with a specialized type of mapping, i.e. an *Aggregation* is associated with an *Aggregated Mapping*, a *Weak Entity* with a *Weak Mapping*, and a *Subtype* with a *Specialization*.

3.2. Document-oriented NoSQL databases

As stated in (*Katsov, 2012; Vaish, 2013*) several types of NoSQL databases exist: *key-value* databases, *column-oriented* databases, *graph-oriented* databases, *document-oriented* databases and *hybrid* databases (asacombination of the other types).Given the scope of this paper, only the fundamental concepts of document-oriented NoSQL databases, adapted from (*Katsov, 2012; Chodorow, 2013*), will be elaborated.

Collection

In NoSQL databases *collections*are used for storing (i.e. physically grouping) *documents* which are to be accessed collectively (i.e. as a group). This concept corresponds to the *table* concept in relational databases but with the key distinction that the elements of a *collection* (*documents*) may have different structures (sets of fields) whereas all elements of *table* (*rows*) always have the same structure.

Document

A *document*is the main unit of data (stored in some standard format or encoding like JSON) in document-oriented NoSQL databases. The creation of a separate document for each concrete entity (i.e. a normalized structure) is recommended in the following cases (*Hamrah, 2011; MongoDB, 2016*):

- If the embedding of documents would result in a data redundancy which is not outweighed by sufficient read performance advantages;
- When representing complex M:M relationships;
- When the data set that is to be modeled is large and has a hierarchical data structure.

The elements of a document (i.e. its fields) can be either simple fields (holding a value), arrays of elements or sub-documents.

Identifier

The *_id* field is used for representing a unique attribute (i.e. an identifier) in document-oriented NoSQL databases. The value ofan *_id* field must be unique in a collection. If the user does not specify a value for this field, the value will be automatically generated. The value of the *_id* field can be of any data type, save for arrays, and it is immutable. The *_id* field must appear as the first field in a document. If it is not specified as the first field in a document, it will be relocated to the beginning of the document.

As stated in (*MongoDB, 2016*)the key issue when designing data models revolves around the structure of the documents and how the relationships between the documents will be represented.Contrary to relational databases, most NoSQL databases do not support the joining of documents in queries. Thus, when it is necessary to relate documents, one option is to store a *reference* to a document within another document (which results in a normalized database structure) while the other option is to store an entire document within another document (which results in a denormalized database structure).

Reference

Referencing is accomplished by storing the value of the *_id* field of one document (i.e. a reference to the document) in another document thereby relating the two documents. Given that NoSQL databases do not provide support for resolving references, it is necessary to execute a separate query in order to retrieve the referenced object. Thus, while references provide greater flexibility, in comparison with embedded structures, their main drawback is that they inherently necessitate the “generation” of multiple queries when retrieving a complex data structure, whereas with embedded structures the entire data structure can be obtained by a single query.

Sub-document

A sub-document is a document which is stored within another document. In contrast to references, where only the identifier of the document is stored in another document, in this case the entire structure of the document is stored (i.e. embedded) within the other document. This approach is recommended in the following cases (*Hamrah, 2011; Chodorow, 2013; MongoDB, 2016*):

- When representing weak objects;
- When representing 1:M or 1:1 relationships, and the embedded documents should always be displayed within the context of the main document.

The creation of sub-documents yields better read operation performances, in comparison with references, as all of the related data can be retrieved in a single queryand, in addition, the sub-documents can also be updated using a single write operation. However, the creation of sub-documents can lead to an increase in the size of the main document after its initial creation (for example, if an invoice, initially containing three items, is created and stored in the database, and subsequently five additional items are added) and the additional memory may entailthe relocation or fragmentation of data on the disc which is an expensive operation(*MongoDB, 2016*).

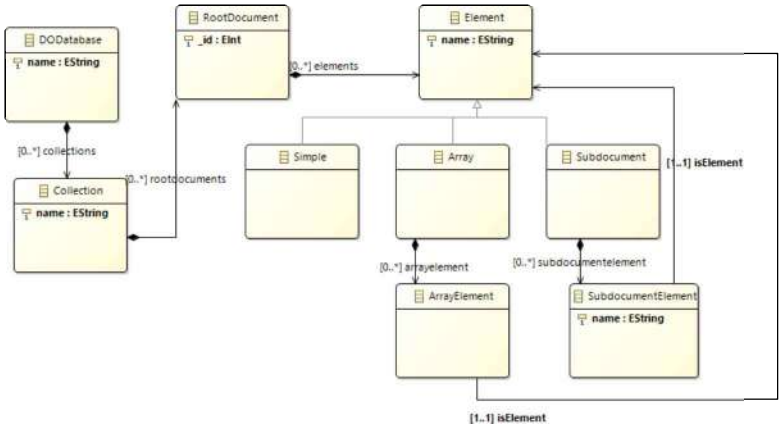


Figure 2: Document-oriented NoSQL database metamodel

4. PROPOSED APPROACH

In general, to design a database is to decide how to organize data into specific forms and how to access them (*Chen, 1976*). Database design is usually conducted in three phases (*Simsion& Witt, 2004*): conceptual, logical and physical design. The proposed approach also follows these three phases:

- Conceptual design – during which the real-world concepts, and their relationships are defined using an EER model.
- Logical design – during which the real-world concept are mapped onto NoSQL database concepts.
- Physical design – .during which additional physical characteristics of the NoSQL database are defined (e.g. indexes, etc).

Due to space constraints, and given the focus of this paper, only the conceptual and logical design phases will be further elaborated and illustrated.

4.1. Conceptual design

The conceptual design phase of the proposed approach would not significantly differ from the conceptual design of relational databases. In this phase the relevant real-world concepts are identified and their attributes and relationships are defined. The utilization of the EER model, as a semantically rich data model, is proposed for the conceptual design of NoSQL document-oriented databases.

The EER model which will be used for illustrating the proposed approach is presented in Figure 3. The *Person*, *Department*, *Course*and *Student Organization* represent strong entities. A *Person* is further specialized into either a *Professor* or a *Student*. A *Student* can be a member of multiple *Student*

Organizations. A *Professor* can belong to one and only one *Department*. The *Pay Slips* for each professor are recorded as weak entities. An *Exam* is an aggregation of the *Student*, *Course* and *Professor* entities.

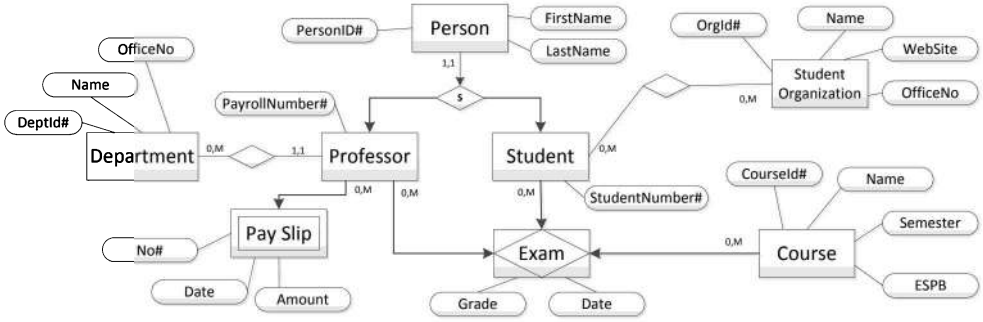


Figure 3: An example of an EER model, adapted from (*Lazarević et al, 2016*)

4.2. Logical design

In the course of the logical design phase, the concepts, which have been identified in the conceptual modelling phase, are transformed into NoSQL database concepts using a set of rules for mapping (transforming) EER concepts onto NoSQL document-oriented concepts. The proposed rules(*Stojimirović& al, 2015*), Figure 4,have been formulated in accordance with the existing recommendations and best practices in this field (*Katsov, 2012; Lazarević& al, 2016; Vaish, 2013; Baker & al, 2011*).

Rule R1: *A strong entity is transformed into either a document or a sub-document. If a strong entity is transformed into a document, then the identifier of the strong entity becomes the identifier of the corresponding database document. If the strong entity is transformed into a sub-document then the identifier of the strong entity becomes a field in the corresponding sub-document.*

Rule R2: *A subtype is transformed into a document. The identifier of the supertype becomes the identifier of the corresponding database document.*

Rule R3: *A weak entity is transformed into an array of sub-documents. The identifier of the weak entity becomes a field in the corresponding sub-document.*

Rule R4: *An aggregation is transformed into either a document or a sub-document. If the aggregation is transformed into a document, then the identifier of the document will either be the identifier of the entity which participates in the mapping with maximal cardinality of "one", or a composite identifier consisting of the identifiers of the entities participating in the mapping with a maximal cardinality "many". If the aggregation is transformed into a sub-document document, then the identifiers of the participating entities (except for the entity corresponding to the document in which the sub-document is embedded) will become fields in the sub-document.*

*Relationships with M:M cardinality are regarded as aggregated entities, thus Rule **R4** will also be applied to such aggregated entities.*

Rule R5: All entities which are transformed, by applying rules ***R1*** through ***R4***, into documents, also become collections.

Rule R6: *The attributes of an entity become the fields of the document, or sub-document, corresponding to the entity.*

Rule R7: *The identifiers of all entities onto which a given entity is mapped with a maximal cardinality of "one", become fields in the document (or sub-document) corresponding to the given entity.*

Rule R8: The *fields, obtained by applying rule **R7**, represent references.*

Figure 4: The rules for transforming EER concepts into document-oriented NoSQL concepts

The outcome of this phase is a logical model of the database structure. It should be emphasized that, as is the case with any other design, several different logical models can be derived from the same conceptual model.One approach would be to model a completely normalized structure. Given that a NoSQL *collection* can be regarded as being similar to the *table* concept in relational databases, all EER entities (i.e. strong and subtype), save for weak entities, can be transformed into separate collections. On the other hand, since the collection concept, unlike the table concept, does not prescribe the structure of documents that will be stored within the collection, it is also possible for all entity types to be stored in a single collection. Consequently, the first step is to determine which collections will exist in the database. The next step would then be to establish which entity will be stored in which collection, unless the creation of separate collections for each type of document was decided on. Finally the established transformation rules will be applied.

Rule ***R1***states that a strong entity can be transformed into either a document or a sub-document. The application of this ruleto the EER model in Figure 3, resultsin four types of documents: *Department*, *Student organization*, *Course*and *Person*. Given that these entities also have attributes, rule ***R6***is also applied, so the attributes of each entity become fields in their corresponding documents.Figure 5depicts a representation of instances of these entities, stored as concrete NoSQL documents. It should be noted that a strong entity can

also be transformed into a sub-document. This type of transformation is performed when, for optimization purposes, an entity on the "many" side of a 1:M relationship is regarded as a weak entity.

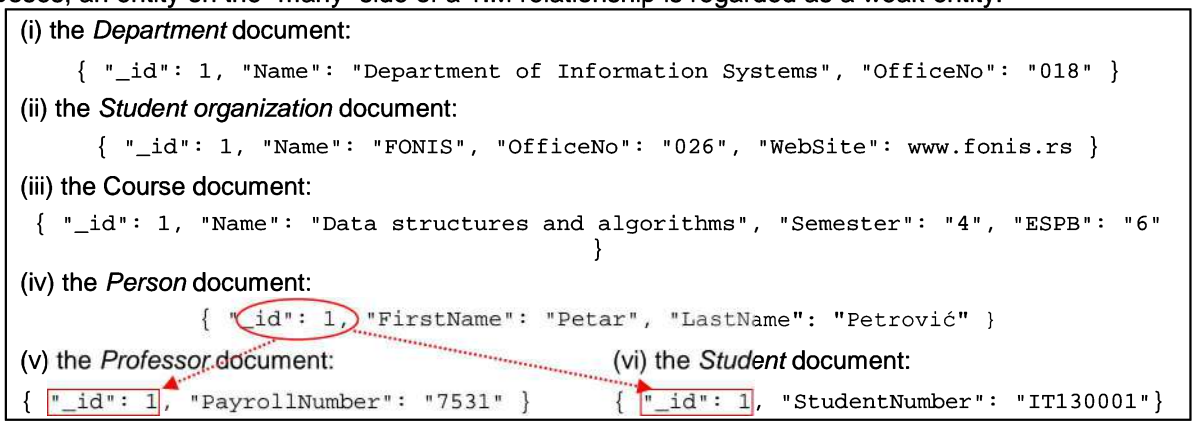


Figure 5: Examples of concrete NoSQL documents

Rule ***R2***is related to the mapping of subtypes which are transformed into documents. By applying rules ***R2***and ***R6*** to the *Professor* and *Student*subtypestwo additional documents are obtained, Figure 5 (v)and (vi).

Since a weak entityis both existence dependent and identifier dependent on itsstrong entity, it will be transformed into an array of sub-documents within the document corresponding to the strong entity.Aweak entity in an EER model cannot exist without the existence of its parent entity. The same principle applies to sub-documents in document-oriented NoSQL databases.Consequently, the deletion of the parent document from the database also entails the deletion of its sub-documents, as they are contained within the parent. In the EER model (Figure 3) the *Pay Slip* entity is a weak entity of the *Professor* entity. By applying rule ***R3***it is transformed into an array of sub-documentsof the document corresponding to the *Professor* entityFigure 6.

the *Professor* document:

```
{
    "_id": 1,
    "PayrollNumber": "7531",
    "PaySlip": [
      { "No": 1, "Date": "15.03.2016.", "Amount": 35743.41 },
      { "No": 2, "Date": "31.03.2016.", "Amount": 31454.22 }
    ]
}
```

Figure 6: Aconcrete NoSQL document with a sub-document

The *Exam* aggregation of three entities: *Course*, *Student* and *Professor*in Figure 3,is transformed by applying rule ***R4***. In this case there are two options, either the *Exam* entity will be transformed into a document, or it will be transformed into a sub-document of one of the documents corresponding to the participating entities. The choice will depend on the intended usage of the stored data.

If the first option is chosen then a concrete *Exam* documentwill be stored in the database. Its *_id* field will be a subdocument containing the identifiers of the documents corresponding to the entities participating in the aggregation (since an *_id* field of a document cannot be an array). In the depicted example (Figure 7), the identifier of an *Exam* document is composedfrom the *Course_id*, *Student_id*, and *Professor_id* fields.

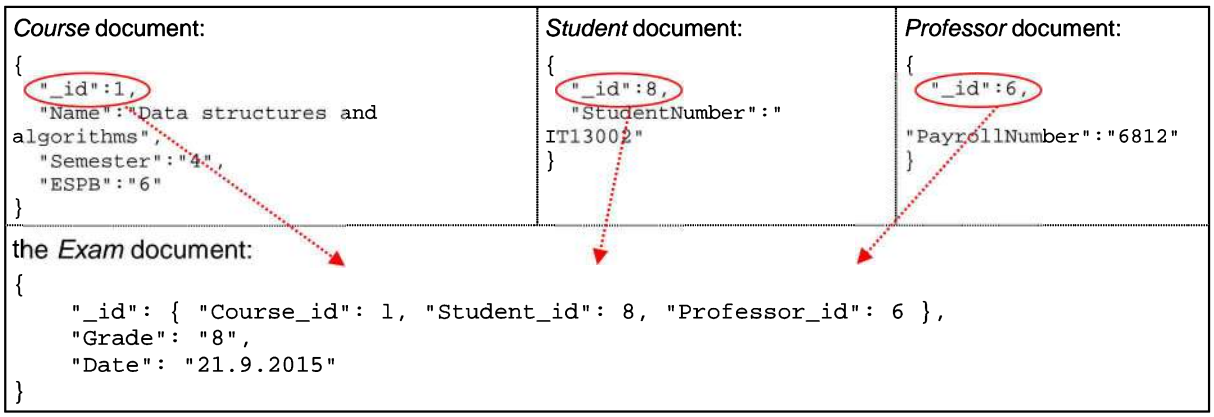


Figure 7: An example of a concrete NoSQL document generated by transforming an *Aggregation*instance

However, if the application requires that the exam results are customarily to be viewed alongside the student data, and are only occasionally to be displayed summarized per professor or course, a better approach would be to choose the second option and transform the *Exam* entity into an array of sub-documents of the *Student* entity. The identifiers of the documents corresponding to other entities participating in this aggregation (i.e. *Course* and *Professor*) will then become fields of a sub-document. A concrete example of one such document is shown in Figure 8. It should be emphasized that the *Exam* entity could be transformed into a sub-document of any of the documents (or sub-documents) corresponding to the entities participating in the aggregation. The choice is left to the designer, and will depend on the application requirements.

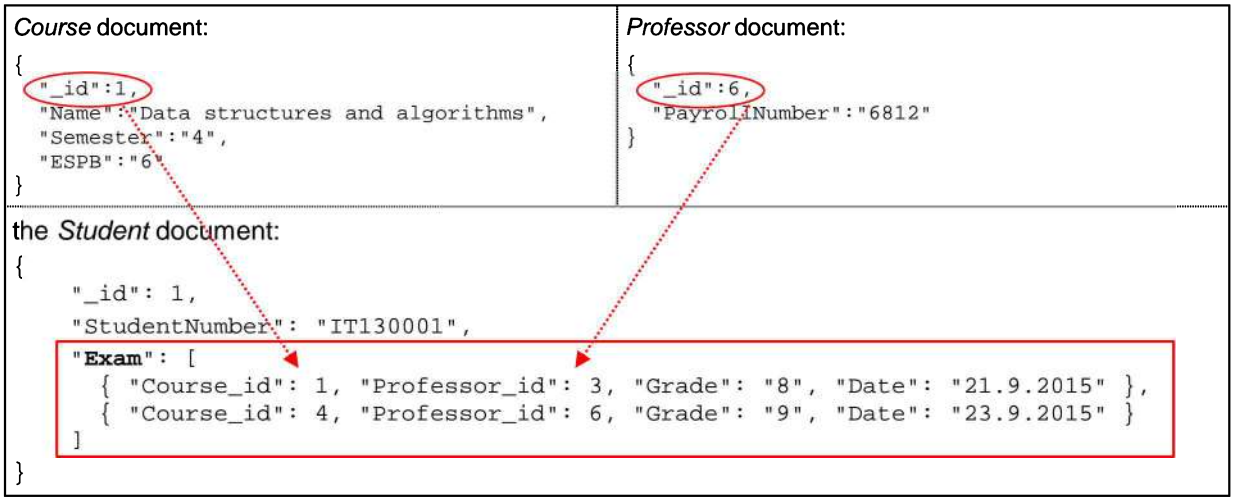


Figure 8: An example an *Aggregation* instance transformed into a concrete NoSQL sub-document

The main advantage of the first approach (i.e. a normalized structure with aggregations transformed into documents) is that such a structure offers greater flexibilityand is more easily maintained in comparison with the second approach (when aggregations are transformed into sub-documents). On the downside thefirst approach entails the execution of multiple queries in order to retrieve the relevant data.

4.3. Automating the execution of the transformation rules

The manual application of the transformation rules and coding of the necessary CRUD operations (responsible for manipulating the stored data) can, as mentioned in Section 1, be a very complex and error-prone task. The absence of a database schema makes this task even more challenging, given that it is impossible to check whether the data is actually stored in the correct format. Thus this paper suggests a means for automatically generating the code (necessary to create the data structures and corresponding CRUD operations for a document-oriented NoSQL database) from a conceptual EER model.

As defined in (*OMG, 2014*): “transformation specifications [in the context of MDD] provide the mechanisms to transform between representations and levels of abstraction or architectural layers”. In general, the transformation specification is based on a set of rules which define how the concepts of a source model (in this case an EER metamodel) are to be automatically transformed into the concepts of a target model (in this case a document-oriented NoSQL database metamodel). The transformation specification is then executed by a transformation engine which has an EER model (conforming to the EER metamodel) as its input and

generates the necessary artifacts as its output. Since document-oriented NoSQL databases, contrary to relational databases, do not possess a schema, the suggested approach would not follow the traditional EER -to-relational model transformation. It is proposed that the specified transformation could be a model-to-text transformation (M2T), wherein the source would be an EER model while the generated target would be a textual artefactrepresenting code (e.g. Java). The proposed approach suggests that three artifacts should be generated: the domain classes (for representing the in-memory object model in which the data will be stored at runtime), a generator (responsible for knowing how to transform an object into a JSON document using generated text templates storing the structure of a concrete document type) and brokers (responsible for executing the CRUD operations by invoking the generator to obtain concrete JSON documents).

Thus the first step would be to map the EER metamodel elements onto the document-oriented NoSQL database metamodel concepts. However, in order to obtain the flexibility, which the presented rules offer, the designer would need to specify, for those rules which provide alternatives, how certain concrete concepts should be interpreted e.g. how to transform aggregations, or if strong entities should be transformed into sub-documents. In general this can be accomplished in two ways: either by annotating the concrete EER model elements or by initially configuring the engine throughstatic rules providing the desired settings as XMI.
The transformation engine would read a concrete EER model and use a visitor pattern, such as topological sortor a similar algorithm, to traverse the EER model (and for each element its related elements would be visited)whereupon the necessary domain classes, brokers and JSON generator (based on text templates representing the structure of the corresponding document types) would be generated, on the basis of the specified metamodel mappings and, if prescribed, the EER model annotations. At runtime, upon the invocation of a concrete CRUD operation, the broker, responsible for the execution of the operation, would invoke the generator which would extract the information from the domain objects and populate the previously generated document template with the concrete values, thereby generating a concrete JSON document that can be stored in the document-oriented NoSQL database. The metamodels, EER model instances and transformation rules could be stored, for example, as XML (eXtensible Markup Language) documents conforming to the XMI (XML Metadata Interchange) standard, while the transformation engine could be built using e.g. Java code or, preferably an existing one could be used.

5. CONCLUSION

Contrary to relational databases, NoSQL databases do not enforce a database schema and, in addition, in relational models the data structure is decoupled from the actual data, which is not the case with the JSON documents stored in a document-oriented NoSQL database. Yet it is still necessary to design the data structures that will be stored in a NoSQL database in order to be able to correctly manipulate the stored data in an application. A possible approach to automating the design of NoSQL document-oriented databases, in accordance with the leading approach to software development today – MDD, is outlined in this paper. The aim is to automatically generate the data structures and corresponding CRUD operations for a document-oriented NoSQL database, from a conceptual model. Consequently, there would be no need for the error-prone manually coding of CRUD functionality.In the presented approach semantically rich Extended Entity-Relationship models are used as conceptual data models. The rules for transforming EER concepts into NoSQL document-oriented database concepts are presented, and a possible approach to automating these rules is outlined.

If the transformation is automated there would be no need for manually coding the CRUD functionality (which is usually very time-consuming and prone to errors). Thus the proposed approach reduces the risks of incorrect mappings, thereby ensuring consistency and reliability, while at the same time increasing productivity and lowering the costs of web application development. Moreover, the runtime performances of a web application would be accelerated, as it will not be necessary to store the object mappings separately and then check theses mappings, to determine the how to handle an object (document), each time a CRUD operation is to be executed, rather the entire manipulation logic will already be embedded in the code.

Future work would be aimed at providing a concrete implementation of the proposed approachand testing it in different real-life scenarios.

REFERENCES

Baker, J., Bond, C., Corbett, J. C., Furman, J. J., Khorlin, A., Larson, J., ...&Yushprakh, V. (2011). *Megastore: Providing Scalable, Highly Available Storage for Interactive Services.* In Proc. of Conference on Innovative Data system Research– CIDR (Asilomar, CA, USA), pp. 223-234.

Bugiotti, F., Cabibbo, L., Atzeni, P., &Torlone, R. (2013).*A Logical Approach to NoSQL Databases.*Retrieved from:http://cabibbo.dia.uniroma3.it/pub/noam.pdf

Chen, P.P.S. (1976). The entity-relationship model – toward a unified view of data.*ACM Transactions on Database Systems (TODS)*,1(1), 9-36.

Chodorow, K. (2013).*MongoDB: the definitive guide* (2nd ed.).Sebastopol: O'Reilly Media, Inc.
Hamrah, M. (2011*). Data modeling at scale: MongoDB+ mongoid, callbacks, and denormalizing data for efficiency*.Retrieved fromhttp://blog.michaelhamrah.com/2011/08/data-modeling-at-scale-mongodb-mongoid-callbacks-and-denormalizing-data-for-efficiency/
Katsov, I. (2012). *NoSQL data modeling techniques*.Retrieved from Highly Scalable Blog:https://highlyscalable.wordpress.com/2012/03/01/nosql-data-modeling-techniques/
Lazarević, B., Marjanović, Z., Aničić, N., Babarogić, S. (2016).*Bazepodataka* (7thed.). Beograd: Fakultetorganizacionihnauka.
MongoDB (2016).*MongoDB Reference Manual*. Retrieved from http://docs.mongodb.org/manual/
OMG (2014).*MDA Guide, Revision 2.0*. Retrieved from http://www.omg.org/cgi-bin/doc?ormsc/14-06-01
Sadalage, P.J., &Fowler M. (2012).*NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence*. Addison-Wesley.
Simsion, G., & Witt, G. (2004).*Data modeling essentials*. San Francisco: Morgan Kaufmann Publishers.
Stojimirović, D., Nešković, S., Babarogić, S. (2015).Predlog postupka projektovanja NoSQL baza podataka zasnovanih na dokumentima. In Proc. of YU INFO 2015 (Kopaonik, Serbia), pp. 115-120.
Vaish, G. (2013).*Getting started with NoSQL*.Birmingham: Packt Publishing Ltd.

STRATEGIC MANAGEMENT 1290

INTEGRATED PERFORMANCE MANAGEMENT FROM A UNIVERSITY PERSPECTIVE 1291
Skoog Matti, Vesovic Vladimir

FRAMEWORK FOR STRATEGIC PERFORMANCE MANAGEMENT IN THE MEDIA INDUSTRY 1296
Marić Nataša, Obradović Vladimir, Cicvarić Kostić Slavica

DEVELOPMENT AND TRENDS IN THE MANAGEMENT CONSULTING INDUSTRY 1305
Krivokapić Jovan, Savić Milica, Čudanov Mladen

APPLYING A GENERAL MORPHOLOGICAL ANALYSIS IN LONG-TERM DEFENCE PLANNING PROCESS 1312
Kankaraš Milan, Stojković Dejan, Lojić Ranko

PROGNOSTIC RESEARCH IN THE FUNCTION OF STRATEGIC DEFENSE PLANNING 1319
Blagojević Srđan, Ristić Vladimir, Bojanic Dragan

ON METHODOLOGICAL APPROACHES TO DEFENCE SECTOR REFORM 1325
Nikolic Nebojsa

STRATEGIC PERFORMANCE MANAGEMENT SYSTEM IN PUBLIC SECTOR: THE ROLE OF KNOWLEDGE MANAGEMENT 1331
Mitrović Zorica, Bjelica Dragan, Toljaga Nikolić Danijela

THE SIGNIFICANCE OF THE PARADIGM OF GRADUAL EVOLUTION FOR THE DEVELOPMENT OF THE DEFENCE SYSTEM 1339
Ristic Vladimir, Blagojević Srdjan

ANALYSIS OF POSTAL MARKET AS A PRECONDITION DEFINING THE MODEL ACCESS TO POSTAL NETWORK IN REPUBLIC OF SERBIA 1346
Unterberger Marija, Šarac Dragana, Ožegović Spasenija

MEASURING SECURITY MANAGEMENT PERFORMANCE 1354
Bojanic Dragan

MILLENNIALS AS A FUTURE DOMINANT WORKFORCE- STRATEGIC FRAMEWORK FOR UNDERSTANDING AND CREATING CHALLENGING ENVIRONMENT 1359
Ilić Tanja, Pavićević Milica

STRATEGIC MANAGEMENT

INTEGRATED PERFORMANCE MANAGEMENT FROM A UNIVERSITY PERSPECTIVE

Matti Skoog, Vladimir Vešović
Stockholm Business School, Stockholm University
matti.skoog@sbs.su.se; vladimir.vesovic@sbs.su.se

Abstract: *This paper takes a strategic perspective on performance management and discusses the integration challenges that most organizational continuously face. This is done by relating an integrated performance management framework to Swedish university organizations way of managing overall performance.*

Keywords*: integrated performance management, university governance, strategic relevance, evaluation*

1. INTRODUCTION

In the higher education discourse and literature, especially in the last decade, one might find terms like globalization, competitiveness, market forces and strategic management (Foskett and Lumby, 2003, Hoffman, 2000, Shattock, 2006). Internationalization and globalization of higher education are topics that have occupied the discourse for many years now and have been a driving force for change, adaptation and improved management of performance and outcomes. The ever-growing need to be competitive, in both the economic and academic sense of the word, affects every aspect of management and leadership as well as the staff and their performance within an education institution. This poses very tough challenges at every management level of the institutions but also affects the teaching and learning processes (Macfarlane, 2004). The shift of the late 20th century towards operational and strategic planning and coordination as well as the accountability movement brought about changes in perspectives on management in general and performance management and measurement more specifically (Foskett and Lumby, 2003, Hoffman, 2000 Skoog&Johansson, 2015).

Different types of stakeholder focuses, given that universities are in most cases and to a large extent state funded, sustainability movements of the last decades, all have influenced governance issues in higher education as well. Being an important part of the society, higher education is now facing challenges of disseminating research results for the sake of performance for its own existence (Skoog&Johansson, 2015).

Higher education institutions (HEIs) have broadened their role from teaching and research to becoming complex, many-sided organizations greatly involved in achieving social inclusion and building the knowledge economy (Shattock 2003). The challenges which HEIs have to face come in various forms and are quite multipart: the new competition created by market forces, financial/funding issues, changing demographics in both student and professional bodies and ever growing concerns and demands from the business sector regarding skills necessary for the work life (Hoffman, 2000).

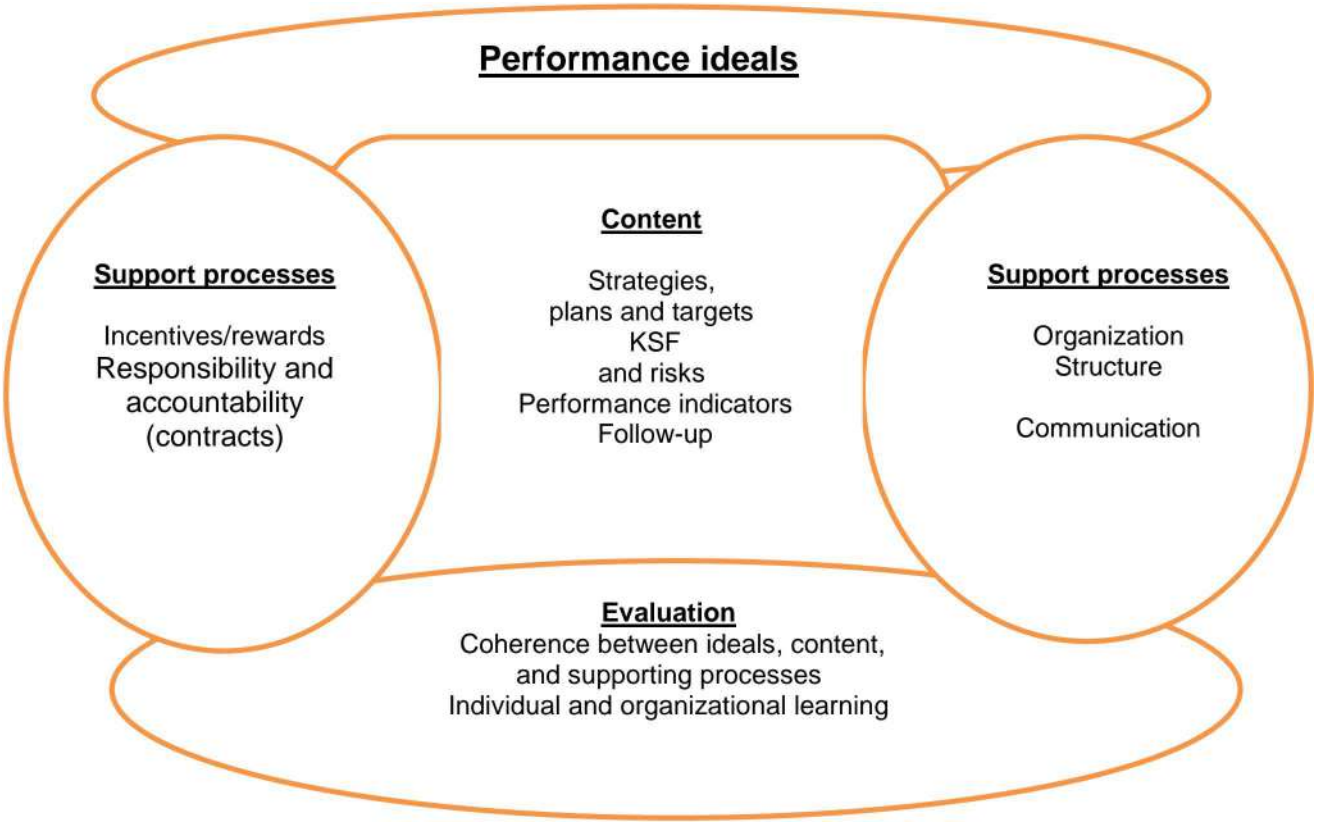
The terms *human resources* and *human resource management* have surfaced in the 1990s as interchangeable alternatives for *personnel* and *personnel management* respectively, with the idea of presenting the human component as much more complex and demanding than before in terms of satisfaction, continuity, stability and performance at work (Orlic, 2005, Armstrong, 2006, Salaman, Storey and Billsberry 2005).

An educational institution is generally no different to a business organization, when it comes to the leadership issues. Furthermore, it is said that it is even more complex and difficult to manage since there are complications in leading academics who, given their professional status, have certain discretionary authorities in their respective areas of work which are in some cases even guaranteed by the legislations in terms of freedom to form one's own research and teaching (Skoog&Johansson, 2015). Today's university lecturers and professors still have the unchanged basic responsibilities and tasks such as teaching, mentoring, evaluating, assessing and counseling students throughout their learning life at the university level and participating and leading research and projects, however, the context has changed significantly in the past decade or so (Macfarlane, 2004). In addition to these tasks there are also responsibilities of evaluation and assessment of internal management and administration, as well as self-evaluation and reporting to higher instances, various committee duties, consultancy and interaction with the society and media, i.e. the performance landscape for academics has been at least partly transformed.

When it comes to management of HEIs there used to be a tendency to look for the step-by-step model, a linear (bureaucratic) model of management and decision making which has in the past decade or so been regarded as "slow-to-react" and inflexible, even too simplistic in relation to contemporary educational issues (Hoffman, 2000). In the last part of the 1990s there was a shift towards more coherent and strategic performance approach which includes more planning than reflection, meaning more prediction of influencing factors rather than just analyzing decisions after they are already made (Hoffman, 2000, Skoog&Johansson, 2015). New models of governance, originating from business organizations, have made their way in the public sector arena. New Public Management, managerial accounting focusing on decision makers, budget steering and control, balanced scorecard, integrated reporting, are merely examples of theoretical models converted to praxis in the business world that have found their way in the public sector. Being a part of the public sector, higher education is not immune to these new influences. It is safe to say that, in the beginning, strategic planning of physical, financial and human resources became the embraced model in management of HEIs with the center notion of accounting for all the possible variables which could influence the achievement of a more successful overall strategic plan for educational performance and outcomes.

2. APPROACHES AND MODELS

Different approaches are constantly being investigated, analyzed and implemented in order to find the winning combination of administrative and academic management which will, consequently, be capable of achieving good results when it comes to educational outcomes, performance and the overall image of the institution. Furthermore, the desired model of management would have to be able to motivate the academic staff to keep the quality levels high, on one hand, and on the other keep the administrative staff active and stimulated for higher performance and effectiveness. All having in mind the stakeholders and accountability towards the tax payers. Management has become more businesslike with management processes such as strategic planning, resource allocation and performance management that includes physical resources (buildings and teaching spaces), learning support resources (for example, IT support) and human resources (teaching staff, managerial other support staff) and how these interact in producing decent teaching and research performance (Foskett and Lumby, 2003, p. 129). There is probably no *best practice* when it comes to organize management of an academic organization, especially in today's unforgiving conditions of market forces and competition for students and research funding. Educational management systems have been undertaking changes in structure, introducing some business views and models, such as human resource management, strategic planning, New Public Management, etc. But, there is however improvement possibilities for most institutions when it comes to integrating different aspects of performance into the actual management and measurement processes. (Johanson & Skoog, 2015). These improvement possibilities can be identified by using the framework presented below:



In university organizations, as well as in many other organizations, there is a constant challenge to integrate long term ambitions (visions) with more short term targets and operational needs. In order to gain relevance and acceptance in for example the performance evaluation processes organizations needs to not only take a number of supporting processes into account, but also identify and discuss different performance ideas that exists within the organization. Meaning that, performance can be interpreted in various ways, especially within university organizations that needs to perform pedagogically, research oriented and financially to a certain degree at the same time. In order to reach long term acceptance and understanding in relation to different performance processes and targets the supporting processes also seem to play an important role. (Johanson et al, 2001, Johanson & Skoog, 2007, Johanson and Skoog, 2015, and Skoog, 2015 in Lövstedt edt).

3. THE CASE OF INTEGRATED PERFORMANCE MANAGEMENT AT SWEDISH UNIVERSITIES

New models of governance and management of public institutions have, as stated, reached the universities. Being organizations of strongly individualistic character in terms of performance and results, universities' organizational model and structure are difficult to identify in terms of theoretical models. Universities in Sweden are strongly influenced by the bureaucratic and functional models given that they belong to the public service sector, alongside National Tax Office, hospitals and Social Services. The duality of such a system as well as the parallel processes in terms of research and education on one hand, and administration on the other, that occur and steer the universities in different aspects, are a significant challenge to address by the university administration. Many universities have, on top of this, decided to decentralize the decision making process, turning the university central administration into a control unit following up on the operations of the departments. Such a complex organization and context needs a complex, yet implementable and context-oriented governance model which takes into consideration the *soft values* of the organization, such as collegiality in decision making, health and satisfaction at work, stakeholder satisfaction, etc. A model where parts are mutually interactive, processes are formed to support the vision in order to achieve results and evaluation of operations is conducted in each part of the organization for the sake of improvement and learning (Skoog&Johansson, 2015) would be of great support for such an organization. The developed analytical framework for evaluation of governance models, mentioned above, is depicting the importance of integrating visions, content, processes and evaluation. By analyzing different organization from different sectors shown in Skoog&Johansson, 2015, one might conclude that the higher level of integration between these parts of an organization, the higher results it will achieve, both in the terms of financial numbers and the more "soft", non-financial ones. Decentralized organization of Swedish universities poses a challenge for such a governance model. This is not to say that more centralized systems should be in place; it is rather a reminder that the organizational models applied to universities should be contextualized, both in terms of actual implementation, but even more importantly in the terminology used. The, so called, autonomy reform conducted several years ago in the Swedish higher education system reiterated the academic freedom of universities and dropped the micro management approach the government had for many years.

Integrating different governance processes on a departmental level in such conditions, having in mind the constant rise of administrative tasks that educators in general, including higher education faculty are expected to conduct, imply a need of high coordination and high efficiency of internal processes without raising expenditures – do more with what you have.

In analyzing how integrated the different governance processes actually are in a university, we will discuss the aspects crucial to implement in order to achieve higher levels of integration between vision and governance in practice. Discussion is based on experiences in the higher education sector. In the analysis we will be using a model of integrated governance processes as described in Johansson & Skoog (2015) where elements such as governance vision, strategies, goals, critical factors, etc. are described.

An excerpt from Stockholm University Strategies 2015-2018 shows the *vision* for the University:

> *All research at the University should strive to be nationally leading and internationally prominent. Stockholm University should focus on education with close ties to research. The operations should be based on collegial work in strong, independent departments that develop in close collaboration with the University's management functions. The courses and programmes will be reviewed continuously in a strategic effort to achieve the highest possible quality and meet societal needs. The University should actively carry out pedagogical development work and provide an attractive study environment to all students.*

Structurally, the operative part of implementing the strategies lies with the departments, which by decentralized structure consequently have relatively wide independence. *Goals* and *critical factors* are also identified and are, based on experience, applicable across the University regardless of the area of study and research. Issues such as funding of research, internal and external, lack of research and education infrastructure, global competition, drop-out rates and new educational challenges in the classroom are raised among others as challenges the University is facing. Importance of follow up is stressed, however without a clear indication as to the ways this process is to be carried out. This might be a consequence (or a challenge) coming from the decentralized organization, given that the operations are conducted at the department level.

The different nature of the departments has led to different ways of resource distribution. Despite the different nature of the departments, the process of *reward* for achievements is more or less the same for all departments and it is based on the outreach and number of publications for the research part of the resources and the throughput of students, for the teaching part of the resources. In terms of correspondence between reward system and vision, one could say that it is rather high. On the departmental level, the governance models look different depending on the size, area of study and/or other factors, which leads also to differences in implementing the reward system both in terms of teaching and research. Given the collegial model of governance in terms of choosing the administrative and academic leader of a department, the legitimacy that a leader of a department has offers the opportunity of deciding the direction of the departmental research and teaching. These decisions are often conducted in a collegial process; however, there are also cases of one-sided decisions which are inevitably leading to resource distribution that might not always be in line with the University or even department strategies. How does a reward systems' next of kin, the penalty system, works in these cases is unclear; it is even unspoken of, since it unequivocally goes against the core of the Universities – the academic freedom where all researchers are free to choose and conduct their own research. If there are no consequences linked to the research activities that differ dramatically from the ambition (vison), the risk is that the vision becomes an "empty formulation" even if it is formulated based on collegial agreement and has an interdisciplinary orientation. On the other hand, the teaching part suffers often direct penalties which are implemented in the same way across the University – by reclaiming the funding that has not been used in terms of educating the number of students the resources were for or by not transferring extra funding in case the number of students exceeded the budget prognosis. At the same time, reward system is not exactly clear, some would say even existing, when it comes to teaching. Here we have an example of lack of integration of governance processes. Scarce stimulation of the departments' teaching improvement processes, together with complete transfer of responsibility and accountability to the department level in terms of teaching leads inevitably to disparate pedagogy across the University. This is, of course, not to say that diversity in teaching is wrong, rather pointing out an important aspect of integration of leading and management processes.

Another important aspect of integrated governance processes is *responsibility* for the content and follow-up of the results (performance). In the university world, the division of responsibility is clear, at first glance. However, this does not imply that the heads of departments share the vision of the university governing bodies or rectors, simply because they have been given the responsibility of a head of department. Although, it is easy to share the vision of *nationally leading and internationally prominent* research and education, the implementation of different processes if quite different in praxis. The departments are entirely responsible for and are leading the operations in teaching and research, while the University central administration takes on a controller roll. It is only in recent years that the importance of in service training of both academic and administrative heads gained more attention, aimed at supporting the vision spreading, supporting decision making, communication and bearing of decentralized responsibility by the heads of departments.

One very important aspect in achieving synergy between vision and results in any organization, public or private, is attaining and sustaining an overall view of the operations. Having an integrative approach to University governance processes in terms of collegial knowledge and value sharing, and collective leadership processes on one side and administrative procedures, the bureaucratic nature of public organizations on the other, is critical for making sure that the governance and support processes are in line with the responsibility sharing, decision making and follow up of results. Integrating governance processes should include even the *soft, non-material, values* of the organization such as health of all the employees, competence level of the faculty as well as stakeholder satisfaction. How these processes of integration of vision, support processes and evaluation of results can be implemented in a widely decentralized organization is a key challenge. It is significantly more difficult to integrate operations between units of an organization that are individualistic both in terms of how faculty views themselves, but also in the way units are run. Control mechanisms from central administration are viewed as an outside attempt of interfering with the operations, rather than evaluation of results.

4. CONCLUSION

In an organization such as a decentralized university, strategic processes should be initiated from the top with a wide department-based acceptability and accountability in order to achieve the goals set up in the vision. At the same time, the operations at the department level should, in the strategic sense (both short and long term), be in line with the vision, while respecting the academic freedom of the faculty. Transferring the governance and leadership models from other sectors into higher education, without the contextual translation of such models and adaptation to the specific nature of academia, would only create more obstacles in the governance processes. Stakeholders are asking for more practical use of the produced knowledge and research results, as well as higher levels of practical, work related benefits of the education provided to students. Demands from the stakeholders and the society as a whole, on one hand, and balancing state resources between administration, teaching and research on the other, are putting forward the importance of integrating governance, management and measurement processes at the university level.

LITERATURE

Armstrong, M. (2006). *A handbook of human resource management practice. 10th edition.* London: Kogan Page.

Foskett, N. & Lumby, J. (2003). *Leading and managing education. International dimensions.* London: SAGE.

Habersam, Piber, Skoog, (2013).*Knowledge balance sheets in Austrian universities: The implementation, use, and re-shaping of measurement and management practices*in *Critical Perspectives on Accounting*, Volume 24, Issues 4–5, pages 319–337.

Hoffman, A. M. (2000). *Managing Colleges & Universities: Issues for Leadership*. Connecticut: Greenwood Publishing Group, Incorporated. Retrieved October 26th, 2008 from the World Wide Web, http://www04.sub.su.se:2058/lib/sthlmub/Top?id=10018020&layout=document

Johanson, Mårtensson & Skoog (2001).*Measuring to understand intangible performance drivers* in *The European Accounting Review* (2001) 10:3, 407-437.

Johanson, U. & Skoog, M. (2007). *Verksamhetsstyrning – för förändring, förbättring och utveckling*. Stockholm: Liber.

Macfarlane, B. (2004). *Teaching with integrity. The ethics of higher education practice*. London: RoutledgeFalmer.

Orlic, R. (2005). *Kadrovski menadzment (Personnel management).* Belgrade: Zoran Damnjanovic i sinovi.

Salaman, G., Storey, J. & Billsberry, J. (2005). *Strategic human resource management. Theory and practice. A reader. Second edition.* London: SAGE.

Shattock, M. (2003). *Managing successful universities.* London: Open University Press. Retrieved October 26th 2008, from the World Wide Web, http://www04.sub.su.se:2058/lib/sthlmub/Top?id=10175236&layout=document

Shattock, M. (2006). *Managing good governance*. London: Open University Press. Retrieved October 26th 2008, from the World Wide Web, http://www04.sub.su.se:2058/lib/sthlmub/Top?id=10175276&layout=document

Skoog, M. & Johansson, U. (2015). *Integrerad verksamhetsstyrning*. Lund: Studentlitteratur.

Skoog, M. (2015). *Styrutmaningar i skolans mål och resultatuppföljning* in *Ledarskap i skolan – scener från en skolledning vardag* Jan Lövstedt, ed. Lund: Studentlitteratur.

FRAMEWORK FOR STRATEGIC PERFORMANCE MANAGEMENT IN THE MEDIA INDUSTRY

Nataša Marić*[1], Vladimir Obradović[2], Slavica Cicvarić Kostić[2]
[1] Adria Media Group
[2]Faculty of Organizational Sciences, University of Belgrade
*Corresponding author, e-mail: natasamaric91@gmail.com

Abstract: *Performance management become crucial for all media companies which do business in highly competitive market and whose goal is not just to survive, but also to progress in these conditions. Today, media companies in Serbia are aware of the fact that performance management is important part of doing business properly, but still, most of them has performance management implemented partially, not integrated in a whole company. Additional specificity of the media is that performance must be considered from two different, but related perspectives. The first is the perspective of the viewer/reader/listener and the other is perspective of the client/advertiser. The purpose of this paper is to provide guidelines that include useful instructions for setting strategic direction of a company, using specific techniques, creating action, operational and annual plans, properly implementing tracking, reporting and awarding systems all in order to ensure better business results.*

Keywords*: performance, management, media, strategy, plan, technique*

1. INTRODUCTION

Performance management represents a highly used concept which has a major influence on company development and prosperity, all in order to achieve company goals. Performance management can be defined as a result of work of individual employee as well as a work of organizational unit or company in general (Hale, 2003). According to the same author, set of values and principles for performance management includes: focus on a results, systematical approach, having in mind wider picture including process of identifying ways to work efficiently in order to achieve competitive goals, providing added value for the customers, employees and organization, always having in mind that their prosperity is crucial for achieving company goals, cooperation with target groups and individuals that has a major influence on company prosperity, work discipline, fact analysis, participation of future challenges, testing ideas and alternatives as well. Performance as an indicator should have several main characteristics (Woolum, 2011), it should be relevant, time limited, understandable, comparable, measurable, and reliable.

Due to increased competition in business environment, performance management become crucial for all companies whose basic goal is not just to survive, but also to grow. Today, media companies which do business in Serbia are aware of the fact that performance management is important part of doing business properly, but still, most of them has performance management implemented only on highest hierarchy levels, and not integrated in whole company. Additional specificity in the media is that performance must be considered from two different, but still related perspectives. The first is the perspective of a viewer/reader/listener and the other is the perspective of a client/advertiser. The purpose of this paper is to provide guidelines for implementing performance management in media companies. It could be useful not only for top managers of media companies in Serbia, but also for marketing and advertising managers, editors, writers, other company employees and all individuals interested in implementing strategic performance management.

Strategic performance management is an approach that has been elaborated in theory and accepted in the practice. However, to the best of authors' knowledge, its implementation in the media industry, especially in Serbia, has not been examined enough. As one of the author works in a media company in Serbia, the framework presented in this paper is based not only on theoretical background, but also on practical experience. The paper provides several examples that are developed for the purpose of better understanding.

After the introduction, second section presents the framework for performance management. As we focused on the very process, as a part of performance management system, in particular, this section covers setting the strategic direction of a company, plans that have to be prepared, techniques that should be used and evaluation systems that should be implemented. The final section presents concluding remarks.

2. FRAMEWORK FOR IMPLEMENTING PERFORMANCE MANAGEMENT PROCESS IN MEDIA COMPANY

In this paper, authors focused on the process of performance management, as process that helps organization in creating, implementing and changing strategy in order to fulfill stakeholders needs (Verweire & Van den Berghe, 2004). This section follows steps of the process, by presenting the strategic direction of company at the beginning and techniques usually used for transforming strategies into plans. Furthermore, basic plans are presented, as well as systems for evaluation and measurement that should be implemented. Every step is elaborated and supported by examples of media company.

2.1. Setting the strategic direction of a company

At the beginning of the process of performance management, company sets its strategic direction, through defining of mission, vision, values, corporate and business strategies and goals.

According to Obradović V. Petrović D., Mihić M., and Mitrovic Z., (2015) mission statement defines what an organization is, why it exists, and its reason for being. Although there are differences among companies from the media industry, general mission of the media company should be to provide truthful and timely information which can have entertaining, educational and/or informative character. Furthermore, according to Murray and Richardson (2002) vision statement provides a key stakeholders with a picture of what the company corporation ultimately intends to become in the period of five, ten or fifteen years in the future. For media company, vision could be to become absolute leader on local market in next five years.

According to Lencioni (2002) core values are the deeply ingrained principles that guide all of a company's actions and serve as its cultural cornerstones, such as teamwork, trust, professionalism, timely and truthful information and others.

One of the commonly used strategies in media is growth strategy, and company can opt for one of the following: Vertical integration which occurs when a firm takes on activities that were formally done by others on its behalf. In a way, vertical integration is just a special case of diversification, a firm is diversifying into either its suppliers' or its buyers' industries. When a company starts making components for its products or starts distributing products directly to customers, it is a sort of a vertical integration. One example could be when publisher buy its own printing machines or cooperates with distributors and, in that way, has influence on whole process from creating content to the process of selling the final product. Horizontal integration can be defined as a strategy when company cooperate or buy competitor's company. Some examples of horizontal integration in our market can be fined. The first occurred in December 2012 when Kurir bought Adria Media Group and in that way made its portfolio wider. The other example is cooperation between two major televisions with national frequency – Prva TV and B92.

When choosing strategy, company should also consider diversification strategy. Diversification can be either related or unrelated. The key issue here is if the operations of the firm in the new industry share some link with the firm's existing value chain. For example, is there some value-adding activity that can be shared, such as a distribution network, or a marketing competence that both can use. Historically it was thought that related diversification would be better than unrelated diversification. However, the coordination costs of related diversification appear to consume a lot of the expected benefits. Therefore, while most firms seem to engage in related diversification its benefits are only slightly, if at all, better than unrelated (Palich et al., 2000).

After determining the strategy, corporate goals, for a period longer than five years, should be set. Some examples of media company corporate goals should be: 20% revenue increase until 2023 (for printed media and Cable TV such as HBO); placing all TV channels/newspapers/magazines and websites as the best in its market segment until 2023; making portfolio which will be wide enough to satisfy needs of its readers/listeners/spectators in next 7 years; or 25% revenue increase until the end of 2020.

Further step in setting the strategic direction of a company is defining a business strategy. It comprises a set of guiding principles that, when communicated and adopted in the organization, generates a desired pattern of decision making, and according to (Miller, D., 1988)it was shown that strategies must be matched with complementary environments and structures to promote success. In that way company ensures realization of global strategy and achieving company goals.

One of the common used approaches in defining business strategy is by using Ansoff's matrix (Watts, G., Cope, J., & Hulme, M., 1998), that defines possible choices on the basis of two dimensions, products and customers. Combining the existing of new products with existing or new customers, Ansoff proposes market penetration, or product development, and market development or diversification. Another approach in defining business strategy is provided by Porter (1980), who identified three generic strategies. Cost leadership strategy represents a strategy when company lowers its cost in order to place product on a market with lower cost than competitors. In the time of the crisis, media tried to implement this strategy by cutting printing cost and start making low budget shows and series. In the beginning that had major effect on profitability and cash flow, but on a long distance it could negatively affect customers' (viewers/readers/listeners) loyalty, rating and income as well. Second strategy tha can be implement is a differentiation strategy that is mainly used when focusing on customers that are not price sensitive. This strategy should be implemented when company has premium product and when a projected difference between profit before and after differentiation is greater than amount of money spend on a process of differentiating. The third option is focus strategy that can be implemented by both, major and small companies when niche segment is spotted. When they find a niche segment, they must decide, according to the customer needs, to focus on lowering cost or to differentiate. The main idea is to fulfill needs of niche customers by focusing on one or two small segments. The main goal of this strategy is to create that kind of products that practically have no competition.

After defining business strategies, media company should define goals. Business goals are usually set for a less than a five years, and have to be in line with corporate goals. For example, the media company can set following business goals: 10% sale increase of print media in next 3 years (goal for print media industry), 10% increase number of viewers (television with national frequency), or strengthen the position on the market in next 3 years (online and premium cable televisions).

Financial goal for all media is to increase the revenue from the clients' campaigns, and by achieving these goals media company will fulfill strategic goal.

2.2. Techniques

In this paragraph three crucial techniques for implementing strategic performance management and translating strategic direction of a company into plans will be explained. These techniques include Balanced Scorecard, creating strategic and map of processes. The balanced scorecard, BSC, (Kaplan & Norton, 2005) allows managers to look at the business from four important perspectives. It provides answers to four basic questions: How do customers see us? (customer perspective), What must we excel at? (internal business perspective),Can we continue to improve and create value? (innovation and learning perspective) and How do we look to shareholders? (financial perspective)

Media companies usually consider customers perspective as the most important one, but the complexity here comes from the fact that media has two different categories of customers. The first one includes readers/viewers/listeners, while the second includes the clients/advertisers who place their campaigns in media. Because of this complexity, considering customers perspective may be crucial for companies' survival and prosperity.

Usually, media companies in Serbia have more than one "product". For example, one publishing house can have newspaper, weekly and monthly magazines, as well as web sites. Each of these products has its own market share and internal value for the company. Having in mind the whole portfolio of product, media company should manage it. For example, a company should identify the product which has highest future potential and then build business and corporate strategy according to that. In the media industry, one of innovative products with high potential in our market might be YouTube shows, and companies should consider the idea of introducing it in their product portfolio. If media company respects both categories of customers, rise market share with its most profitable product, and at the same time invest in new product which has highest potential, that would lead to better business results.

Strategic map is technique considered as an upgrade of BSC. Main characteristics of strategic map are (Kaplan & Norton, 1992): through integration of crucial processes companies plan the activities in that manner that every employee understands its contribution, it is a pattern that can be used for describing main strategies and it enables organizations to describe its tasks and initiatives that are the foundation of a general strategy. One example of strategic map in the media industry isl be presented in the next table.

Table 1: Example of strategic map of media company

Goals (business strategies)	**10% average sale increase in next 3 years**	**10% rating increase in next 3 years**	**Strengthen the position on the market in next 3 years**
Financial perspective (tasks)	Positive cash flow (advertising revenue)	Positive cash flow (advertising revenue)	Positive cash flow (advertising revenue)
Customers perspective (tasks)	1. High quality of information for customers 2. Reach of a client's campaign 3. Satisfied price/quality ratio		1. High-quality program for which clients are prepared to pay more than average 2. Clients satisfaction of the placed campaign
Internal processes perspective (task)	1. Tracking rating and customers opinion 2. Adequate positioning of a client's campaign 3. Events which have purpose to acquaint clients with brand		
Learning and development perspective (tasks)	1. Employees development 2. Creating knowledge base for the organized events 3. Create knowledge base for all clients		

After creating strategic map, next step is creating processes map. For each of the crucial processes in the company should be created process list.

Every process consists of materials, information and resources entering the process and the output. Next step is defining all process parameters such as target values, place, authorities and all resources needed. For performance management, it is crucial to determine place where activity should be processed and the person who will be responsible for it (Obradović V. Petrović D., Mihić M., and Mitrovic Z., 2015).

2.3. Strategy implementation plan

Stakeholders are essential for a business development. For that reason, it is crucial to observe their impact on business and to permanently plan interactions with them.

When we define our stakeholders, there are a few crucial questions for company management to answer on:

- Where are they now – answering this question we can see how stakeholders see the company, and what is their opinion about it;
- Where we want them to be – one of the goals of project management is to change the state of mind of the stakeholders, from the one it was on the beginning to the one it suits the company best;
- Communication – how do the company communicate with stakeholders?
- Goals – what is the main company goal?

- Activities – What the company should do to reach the target?
- Communication frequency – It is crucial to determine the right frequency. For example, contacting shareholders too often can make them irritated, but on the other hand if we do not communicate with them it can be interpreted as company's indifference;
- Responsibility – As we mentioned in paragraph concerning performance management, it is crucial to have a responsible person in the company for communication with groups of shareholder

In the next table the example of communication plan with customers as a stakeholder is presented. The example shows how we can position customers in print media (magazines).

Table 2: The example of communication plan with customers

Stakeholder	Where are they now	Where we want them to be	Communication	Goals	Activities	Communication frequency	Responsibility
Customers	Stable readership	To maintain loyal readers but also to attract new ones	Placing campaign in other magazines and newspapers	Increase of the number of readers	Better quality Promotional campaigns	5 times a month	Publisher

2.4. Action, operational and annual plan of performance

The most complex phase in implementing strategic performance management is the process of transforming strategy to initiatives and actions. The process of transforming has its own path according to Obradović et al. (2015) and it includes defining program, project and program activities, and defining annual performance plans. Programs/projects must be defined in that way that every task/action has the person responsible for executing it, suitable resources and person responsible for a whole program/project. According to same authors, process of planning has two main phases, identification and planning phase. During identification phase, top management decides whether the project will be realized or not, according to the ratio between needed resources and predicted results. In this phase it is essential to enclose the budget calculation. Planning phase starts after positive decision in identification phase and include next steps, identification and mapping all program/project benefits, choosing the right tasks that will lead to the fulfillment of individual goals and the goal of the company, business changes that will bring the company desired benefits, and profiling the benefits - description and the type of the benefits, link with the program/project mission, a list of outputs and identified risks.

Table 3 presents the example of an action plan of the project which goal is to increase the revenue from selling media space.

Table 3: Example of an action plan

Action plan
Specific goal: Increase revenue (from selling media space)
Project : Organizing events and product presentations for a clients
Description: Organizing an event/presentation during which every brand manager will have an opportunity to present issue/television show/online possibilities, focus groups and all other important information for a clients.
Date: yearly
Project results:
10% revenue increase, 90% right positioned ads, 30% increase results for a clients, all because after listening about the media brands advertiser can better choose the right communication channel to promote

their product or service

Responsible: Brand and advertising managers

Financing: Company invest money

Budget: 10.000€ per presentation

R.B.	Activities	Responsibilities	Duration	Resources	Cost	Result
1	Creating presentation	Brand manager	3 days	Human resources – brand manager, research manager and designer	Uses resources in the company, no additional costs	Final presentation

An operational plan can be defined as a plan prepared by a component of an organization that clearly defines actions it will take to support the strategic objectives and plans of upper management, according to operational plans further develop from strategic initiatives and determine which activities are required. Also, operational plans indicate costs, performance measures and expected results. To ensure that company activities will be carried out properly, it is crucial to assign responsibility to the one person for all activities (Obradović et al., 2015) For easier understanding, next table presents an operational plan for one initiative that is further developed through several activities.

Table 4: Example of an operational plan

Initiative	Activities	Costs	Expected results after 3 years	What will be measured	target	Responsibility
			10% revenue increase	% revenue increase	+3%	
Events for clients	Creating presentation	Depends on various factors, but approximately it is 10.000€	90% right positioned ads	% right positioned ads	+50%	Brand and advertising managers
			30% increase results for a clients	% increase results for a clients	+25%	

Annual plan consists of yearly performance targets and person responsible for achieving them (Obradović et al., 2015). As the most common elements of annual plan, these authors define: strategic targets and tasks, strategies, measures (depending on the level at which we want to show) and the person responsible for the

tasks, Key Performance Indicators – KPI, performance measures, targets and baseline values, and responsible persons.

Next table describes example of one of the target goals in annual plan.

Table 5: Example of an annual plan

Strategic goal				
10% Sale increase in next 3 years, 10% viewers increase in the next 3 years, Better brand position on the market achieved in the next 3 years				
Strategic task				
Positive financial result				
Responsible	Manager of the distribution			
Performance measures	Baseline	N	n+1	n+2
% of sale increase	0%	3%	5%	10%

2.5. Responsibilities and awarding system

After developing plans of activates according to the strategic direction of a company, the rest of the performance management process includes defining the responsibility and awarding system, as well as tracking and reporting system (Obradović V. Petrović D., Mihić M., and Mitrovic Z., 2015).

The employees, depending on their position in a company, have the tasks and obligations they are responsible for. In the media company, responsibilities of employees vary from entire business (CEO and top management), over operations at the level of division (Division Manager), operations at the level of the organizational unit (functional or project managers) to the individual level. For each of these levels it is necessary to define expectations, responsibilities, as well as benefits that employees will receive if they exceed set of the expectations and consequences for the performance below expectations. Some of the performance indicators in the media industry includes readership/viewership/number of visits, or a level of income and the number of campaigns that client's customers book. At the individual level, the most optimal is to do precisely defined job description with the expectations and requirements.

One example of job description is in the next table:

Table 6: Example of the job description with responsibilities

Responsibility – personal responsibility				
No.	Employee	Manager	Duties	Responsibilities
1	Journalist	Editor	Creating content that will be interesting enough to the viewers / readers / listeners, in accordance with the issue policy, agreement with the editor and in accordance with the annual plan.	Personal integrity , ethics , morality , trustworthiness and honesty

The system of responsibilities and reward system in the company are two almost inseparable systems. Reward system should be determined and introduced for each part of the business process. Large media companies' goal is to place adequate content to viewers/readers/listeners in order to be competitive in the market and achieve best possible ratings, because ratings are directly connected with client investment.

Generally, in media company structure one can roughly identify two parts, one that includes, editorial and creative staff, and business part. The editorial and creative part of the company consists of editors, journalist, designers and photo and video crew. They are responsible for creating the content that will be interesting to

viewers/readers/listeners, and their performance parameters are viewership/readership/listenership and general ratings of the company. Goals are set on annual basis but monitored daily, weekly or monthly. Thus, for example, viewing TV programs can be monitored on a daily basis, but the average pulls in a week, and once a month. If there is deviations from the plan, manager needs to take corrective actions that include changing the content and implementation of marketing campaigns in order to further promote the show/program. Creative people generally have their own system of performance measurement and reward.

On the other side, the business team is responsible for the coordination of all segments of the company and communication with clients. Media companies are funded by sales of media space. The objectives for the advertising are to cover all operational costs and achieve positive financial balance. The rewards should be determined and introduced in this part as well..

2.6. Tracking and reporting system

Operational monitoring and reporting systems are set to monitor key performance indicators, strength and weaknesses, target area of potential development and check whether the performance is achieved and set out the measures to be taken in the case that there has been a plan deviation (Ammonos, 2007.). As a part of the operating reporting system there should be some resources planned for getting plan on a track. The following table shows one example of reporting system.

Table 7: Example of tracking and reporting system

Tracking and reporting system						
KPI	**Performance measure**	**Target**	**Current status**	**Deviation**	**Measures when deviations occur**	**Using resources**
Readership increase	5%	5%	6%	1%	Bonus for editorial team	% of money advertising team earned more because od the deviation

Generally, in media two systems must be followed, sales and advertising. All viewership/readership data are permanently monitored in R&D sector in the form of daily and weekly reports. Regarding print media, it is also important to monitor sales in different locations, and react on time if any deviation occurs. For example, monitoring can show that in some cities all distributed magazines are sold out, just in a few days, while in some other cities, stores sell only small percent of distributed magazines. In that case, distribution manager can redistribute printed magazines and increase sales with the same costs. Regarding advertising system, when campaign is to be realized in media, the client must send campaign order, which is processed in finances. Tracking financial report on daily basis, which includes reserved media space and comparison with a target is crucial for fulfilling the company's goal.

3. CONCLUSION

Having in mind the very business of media company, we can identify two key stakeholder groups. The first one includes viewers/readers/listeners, to whom companies from the media industry placed the contents in order to attract their attention. Attracting greater attention will have an effect on the overall rating. The second includes clients who place their campaigns and invest money in media.

This paper presents guidelines for introducing a system for managing performance in the media industry with a purpose to show how through all the steps, form setting strategic direction of a company, creating strategic maps, operational plans, systems of responsibility, and monitoring and reporting as well, company always must have in mind its stakeholders. In the case of media company, by implementing performance management it always will have in mind the customers who are the ones who decide where the clients' campaign will be positioned and how much money client will invest in it. This guidelines might be useful not only for top managers of media companies in Serbia, but also for marketing and advertising managers,

editors, writers, other company employees and all individuals interested in implementing strategic performance management.

We can conclude that in contemporary environment, which is characterized by strong competition, the media themselves cannot afford to stagnate, but must constantly develop their business and improve overall business performance. These guidelines for proper performance management can lead media company to meet the needs of the viewer/reader/listener and consequently attract clients to invest their money, through placing their campaigns.

REFERENCES

Ammons, D. (2007), Performance Measurement: A Tool for Accountability and Performance Measurement. UNC – Chapel Hill School of overnment, 2 - 12

de Lancer Julnes, P., & Holzer, M. (2014). *Performance measurement: Building theory, improving practice*. Routledge.

Entrepreneur Media, Inc. (2016) Retrieved from https://www.entrepreneur.com/encyclopedia/mission-statement

Hale, J. (2003). *Performance-based management: What every manager should do to get results*. John Wiley & Sons.

Kaplan, R, & Norton, D. (1992). The Balanced Scorecard – Measures the Drive performance. Harward Business Review, 72-79

Kaplan, R. S., & Norton, D. P. (2005). The balanced scorecard: measures that drive performance. *Harvard business review*, *83*(7), 172.

Lencioni, P. M. (2002). Make your values mean something. *Harvard business review*, *80*(7), 113-117.

Michael Watkins (2007). Demystifying Strategy: The What, Who, How, and Why. *Harvard business review*

Murray, E. J., & Richardson, P. R. (2002). *Fast forward: organizational change in 100 days*. Oxford University Press.

Obradović V. Petrović D., Mihić M., and Mitrovic Z., (2015) Strateško upravljanje performansama, FON

Sage.Miller, D. (1988). Relating Porter's business strategies to environment and structure: Analysis and performance implications. *Academy of management Journal*, *31*(2), 280-308.

SIG, P. (2001). Performance-Based Management Handbook.

Verweire, K., & Van Den Berghe, L. (Eds.). (2004). Integrated performance management: a guide to strategy implementation.

Watts, G., Cope, J., & Hulme, M. (1998). Ansoff's Matrix, pain and gain: Growth strategies and adaptive learning among small food producers.*International Journal of Entrepreneurial Behavior & Research*, *4*(2), 101-111.

Woolum, J. (2011). Citizen involvement in performance measurement and reporting: A comparative case study from local government. *Public Performance & Management Review*, *35*(1), 79-102.

DEVELOPMENT AND TRENDS IN THE MANAGEMENT CONSULTING INDUSTRY

Jovan Krivokapić*[1], Milica Savić[1], Mladen Čudanov[1]
[1]Faculty of Organizational Sciences, Belgrade, Serbia
*Corresponding author, e-mail: krivokapicj@fon.bg.ac.rs

Abstract: *This paper will introduce the importance of management consulting, its development, as well as the current trends in this industry. A review of the literature and official statistical reports indicates that organizations, due to the lack of necessary expertise, increasingly use consulting services in order to improve their performances, so consulting, both globally and locally is becoming very important concept in the modern business world. Following trends, this industry has changed its face throughout history, and it has especially experienced some turbulent changes in the last hundred years. Today, consulting is most widely used in the field of improving operational performances and financial counselling, but its constant growth in other business areas should also be emphasized.*

Keywords*: management consulting, history, development, current trends*

1. INTRODUCTION

Management consulting has found application in various business activities. It can be said that there is no area without experts who have specialized in providing assistance to those who fail to cope with everyday pressures and difficulties (Florzak, 1999). Even many strong companies no longer consider the option of performing businesses without a help of consultants (O'Mahoney & Markham, 2013), regardless the fact that the price of their involvement is often extremely high. Considering all the benefits that could be gained, the price of such agreements is acceptable.

Having that in mind, the term "*consulting*" can be observed in many ways, from different aspects. There are views that the consultants are all those who are trying to change or improve business processes or situations, although they have no control during the implementation, so it might be noted that there is large number of them in organizations, though not explicitly under that name (Kubr, 2002). A help that is expected of them is most often in the form of providing important information or advices and recommendations concerning the activities that should be performed in order to achieve those objectives, while the client can be both an individual and another organization. Accordingly, it can be said that consulting is "*a process by which an individual or organization assists the client to achieve a stated outcome"* (Biech, 2011). In practice, however, this term is usually narrowly observed, and it can be defined as "*knowledge-intensive service which independent business professionals provide to managers of client organizations, and consists of objective advice on management's decisions regarding the solutions to the client organization's problems and opportunities"* (Baaij, 2013). Just like the other services, consulting does not have tangible outputs (Haksever & Render, 2013), but the effects of this kind of cooperation can be both observed and measured (Phillips, Trotter, & Phillips, 2015). However, it is not an easy task. Specific problem arises when there is a number of factors that influence the results gained by the client after the implementation of the proposed solutions (Baaij, 2013), so sometimes it cannot be said with certainty that the consultants' solutions led to the observed changes

Despite the fact that the current trends point to increased usage of consulting services, it can be said that the proper significance of consulting was not fully recognized until the last decades of the twentieth century. A review of the relevant literature indicates that up to a few decades ago a small number of researchers have pointed out the potentials of consulting industry (Armbrüster, 2006). Since then, the situation has changed significantly, and this statement might be supported through the analysis of the growth of this industry, which indicates that the total revenues in this field has increased more than one hundred times in the last thirty years (O'Mahoney & Markham, 2013).

2. A BRIEF HISTORY OF MANAGEMENT CONSULTING

Consulting is a very old industry, but through the history its role was significantly different from the concept as we know it in the twenty-first century. Initially, the role of consultants was mainly in the provision of specific advices and recommendations to the rulers and members of the higher social classes. However,

with the growing complexity of relationships in the markets, this role has changed and evolved significantly, so that in the last few centuries, following the significant improvement of the economy, consulting gets real contours of what it represents now.

Radical changes in consulting activities have occurred after the industrial revolution, especially at the end of the nineteenth century, with the advent of scientific management. Many organizations have decided to hire experts whose task was to improve the existing methods of work, and therefore provide a more rational use of resources. Frederick Taylor, his associates and other followers who modified and improved his ideas had special importance in the development of consulting services in this period. They have written a large number of professional articles and have performed many practical experiments with the idea to improve operational processes, which laid the foundations of modern consulting. These principles of management and organization have found extensive application in industrial companies throughout the United States and Europe, so the workers had the opportunity to increase their earnings, if they were able to produce much more than they did before (Jaško, Čudanov, Jevtić, & Krivokapić, 2013).

Due to a certain degree of exploitation of the employees, following decades have brought many analysis on their needs and behaviors in the workplace, in order to discover main factors that influence their commitment and motivation. Studies from this period pointed to the importance of the human factor, thus creating conditions for the development of the behavioral management. Numerous studies have shown that various intangible incentives have a significant impact on productivity (Cropf, 2008), thus causing the change of previous attitudes about the nature of business management. Organizations were increasingly focused on the analysis of the factors that affect the motivation of employees, their commitment, job satisfaction, and the results they achieve (Jaško, Čudanov, Jevtić, & Krivokapić, 2013), which led to the review of the management but also of the consultancy focus. Consequently, it resulted in large differences in the characteristics of consulting based on these two concepts, with more attention devoted to the strategic consulting. Comparative review of these perspectives is shown in the following table.

Table 1: Historical Management Perspectives (Stryker, 2011)

Period	**Perspective**	
	Scientific Management	**Behavioral Management**
Early (1890 – 1920)	▪ Few consulting firms ▪ Use of scientific method ▪ Emphasize on efficiency ▪ Principles of management articulated ▪ Time-motion studies ▪ Accent on material incentives	▪ No consulting firms ▪ Based on scientific method ▪ Emphasize on effectiveness ▪ Accent on employee education
Middle (1920 – 1940)	▪ Private sector consulting ▪ Extended scientific method ▪ Emphasize on efficiency ▪ Principles of management extended ▪ Work simplification ▪ Accent on material and individual incentives	▪ Consulting institutes ▪ Based on behavior studies ▪ Emphasize on effectiveness ▪ Employee-centered management ▪ Accent on personnel department
Modern (1940 - ?)	▪ Public-private sector consulting ▪ Based on Operations Research methods and techniques ▪ Emphasize on efficiency ▪ Generalized management principles ▪ Methods analysis ▪ Accent on material and individual incentives ▪ International consulting	▪ Public-private sector consulting ▪ Based on Organization Development methods and techniques ▪ Emphasize on effectiveness ▪ Participative management ▪ Accent on personnel training and counselling

In the mid-twentieth century, and especially in the years following the World War II, consulting services have begun to appear in almost all developed countries. It was believed that many organizations were unable to recover after years of war and crisis, so it was necessary to seek the assistance of external experts (Biggs,

2010). This is the period marked with the geographic expansion of consulting, and this growth was followed by significant changes that were reflected in (Kubr, 2002):

- Wider and more diversified service offerings,
- Growing competition in consulting,
- Internationalization of these services,
- Progress in the methodology of consulting,
- Progress in the technology that was used,
- Increased client competence in using consultants' services,
- Emergence of large consulting organizations,
- Internal consulting.

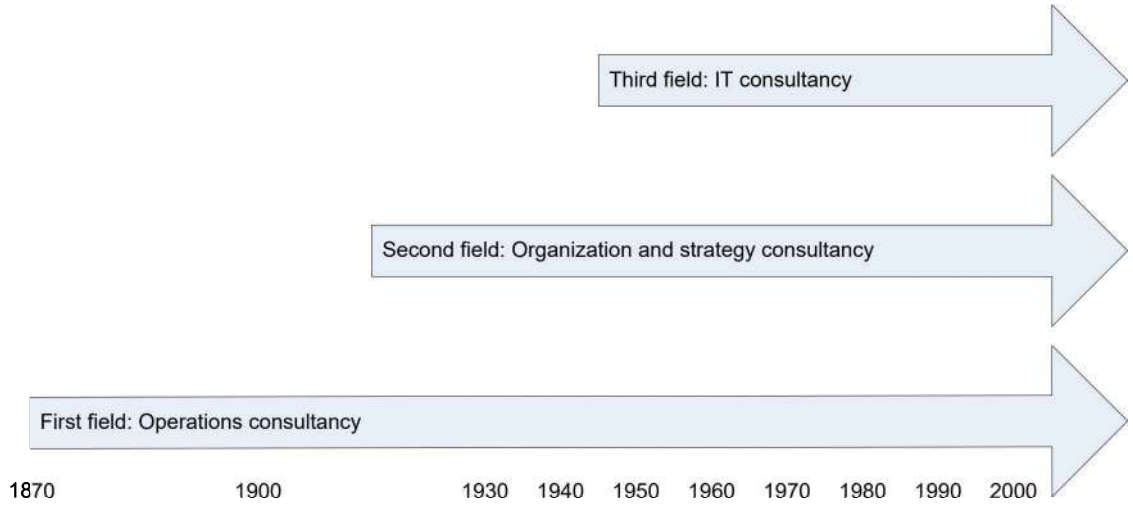


Figure 1: The emergence of management consulting fields (Baaij, 2013)

At the end of the twentieth century, the IT revolution predominantly shaped the nature of consulting (McKenna, 2006). This period is considered to be the golden era of consulting, since the annual growth of the industry ranged from 15 to 20% (Poulfelt, Greiner, & Bhambri, 2010). This growth has stagnated during the first years of twenty-first century, but it achieved stability again at a bit lower rate during the current decade (O'Mahoney & Markham, 2013).

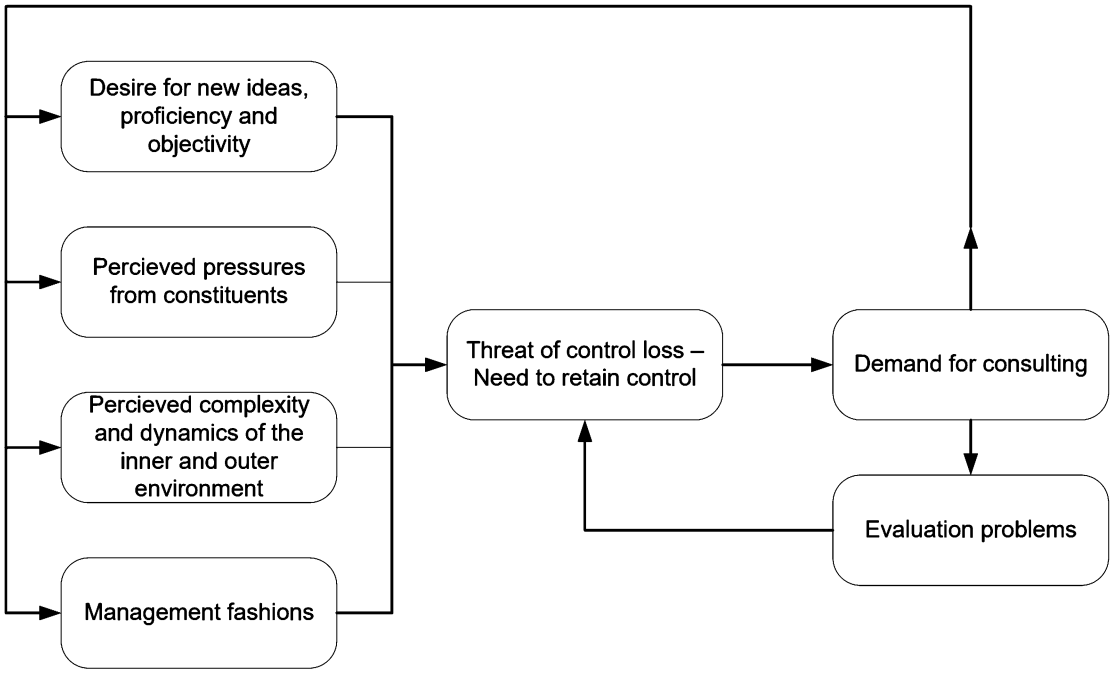


Figure 2: Factors leading to the growth in demand for consultants (Orr & Orr, 2013)

It should be noted that in recent decades the consulting industry was developing faster than the economies of many western countries (Kipping & Clark, 2012). Many large consulting companies decided to expand their offer, following some new problems that have emerged, but it is also interesting that many organizations which previously have not been engaged in consulting started to provide specialized services in a search of new business opportunities (Kubr, 2002). The previous illustration shows a set of factors that influence the demand for consulting services.

3. CURRENT TRENDS IN MANAGEMENT CONSULTING

Many authors point out that the consulting industry is now more focused on providing expertise in terms of organizational and strategic planning rather than making recommendations in order to increase efficiency at the lower level (Wright & Kipping, 2012). Through the analyses of the statistical data on consulting, it can be concluded that there are different views on its wideness, which sets the stage for discussion on the actual size of the consulting industry. Widely observed, the value of this market is over $330 billion (O'Mahoney & Markham, 2013). However, according to the reports of Kennedy Information LLC, leading information source on management consulting, the total value of this market is a little less than $250 billion (Consultancy.uk, 2016). In any case, estimations of this market value it higher than five-fold GDP of Republic of Serbia in the year of 2014th. These reports also confirm that there is a constant growth of this value during the second decade of the twenty-first century, while dominant consulting fields are related to operational improvement and financial consulting

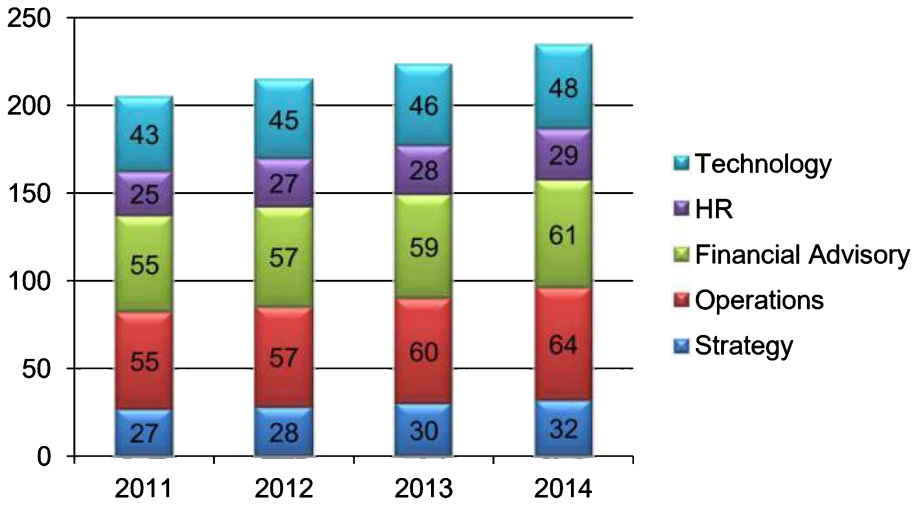


Figure 3: Size of the global consulting industry in $ billion (Consultancy.uk, 2016)

When it comes to the distribution of these values by regions, it can be concluded that this industry is especially developed in Europe, Middle East and Africa (EMEA) as well as in the countries that belong to the North America.

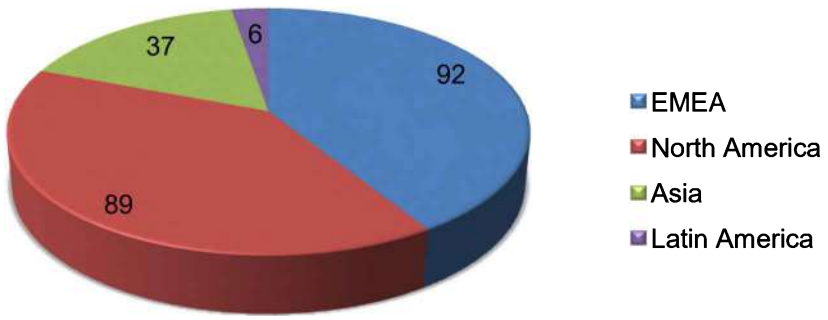


Figure 4: Global consulting market by regions in $ billion (Consultancy.uk, 2016)

The analysis of the European consulting market shows that the most of transactions in this region is conducted in Germany, Austria and Switzerland, but also that consulting services are quite popular in the United Kingdom and the Republic of Ireland. Countries in the Balkans, on the other hand, do not have a large share on this market. It should also be noted that in Europe, as well as at the global level, the highest percentage of the value of provided services is related to the operational, financial and IT consulting, while the strategic and HR consulting appear to be less represented. Concrete values vary among regions, which is not unexpected when it's known that there are differences in the level of economic development among them.

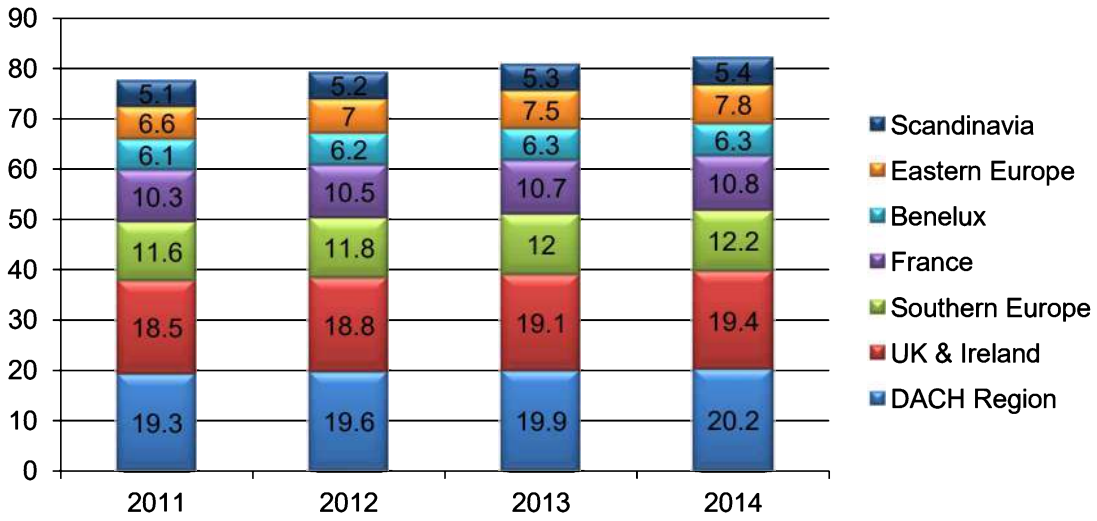


Figure 5: European consulting market in $ billion (Consultancy.uk, 2016)

Nowadays there is a large number of consulting firms that perform their businesses in several countries. The most famous consulting companies are so-called "*The Big Four*" consisting of "*KPMG*", "*PricewaterhouseCoopers*", "*Ernst & Young*" and "*Deloitte*" (WetFeet, 2008). It is interesting that these companies have started businesses by providing consulting services in the field of accounting and auditing, but during the years they have spread spectrum on the management consulting.

Observing modern trends it can be said that consulting organizations could be classified in several categories, such as (Kubr, 2002):

- Large multifunctional consulting firms,
- Strategy and general management consultancies,
- Information technology and e-business consultancies,
- Employee benefits consultancies,
- Medium-sized generalist and specialist firms,
- Sole practitioners and small partnerships,
- The consulting professors,
- Consulting services of management schools and productivity centres,
- Non-traditional suppliers of consulting services,
- Consulting networks.

Having that in mind, the client organizations have options of hiring (Armbrüster, 2006):

1. *External consultants* who can provide services (Werr & Linnarsson, 2002):
   1.1. Temporarily, in order to solve some specific problems for client;
   1.2. On the long term, to help directing the organization constantly towards its goals; and
2. *Internal consultants* who can:
   2.1. Coordinate the efforts of external consultants during the implementation of their projects;
   2.2. Be employed permanently in providing advices and assistance with the critical issues to the management of the organization.

It is interesting that the practice, especially in developed countries, shows a growing trend of engagement of internal consultants (O'Mahoney & Markham, 2013). Their responsibilities are different but mostly related to the issues with the organizational structure and its development, management processes within the organization, new technology and its application, development and training of employees, and so on.

Advantages of hiring internal consultants are numerous (Scott, 2003), as they are very familiar with the organization and therefore they can get better insight into the problems that occur. Also, when the organization has internal consultants, the fear that there will be a spread of confidential information is reduced, and it is very likely that it would be easier to implement changes appropriately, having in mind that employees know these people and trust them more than they trust experts who come from outside.

However, in addition to unquestionable benefits that internal consultants can bring, the fact is that, unlike external consultants, they generally do not have much experience in different situations, and their knowledge and competences are mainly limited to a certain number of problems, which can be a big disadvantage. In addition, the question of their objectivity arises, given the fact that they know other employees and they have established relationships with them, so sometimes it is more difficult for them to decide to make some unpopular moves, although they are aware that that should be the best solution. External consultants do not have this kind of dilemma, and their recommendations are objective and more realistic (Anderson, 2012), but also accompanied by higher resistance in the organization.

4. CONCLUSION

Although consulting practically exists as much as the society does, its role gains in special importance in last hundred years. This industry has been changing its face through the history in order to adapt to the current, mainly economic standings. The analysis of current trends in this field shows that this industry has rapid growth in the last couple of decades and that at this moment its value reaches about $330 billion. It is indicative that the consulting is in general mostly popular in the developed countries, especially in Europe and North America, but there is much space for the improvement in countries in the Balkans.

Regardless of the type of the consulting, it should be noted that nowadays the clients expect not only a recommendation, but more and more some concrete results and improvements. Consultants are no longer seen as advisers but as professionals who need to ensure achievement of the targets, so they have more autonomy and more resources in order to succeed in that. The width of their work is also changing, so the business consulting takes the position of management consulting, which can lead the organization to the complete transformation and change of portfolio activity.

Further research on consulting can develop in several directions. Different practices between “The Big Four”, aimed mostly at consultancy, and strategic, creative consulting practices such as exercised by other large consulting companies, e.g. Bain, McKinsey and BCG can be elaborated by formalizing description of the consulting process and goals. Also, network nature of all observed large organizations can be researched as a specific form of organizational structure, with specific attention to correlations between network parameters (centrality, degree, neighbors, average paths) and performance of the company. Performance of the consulting companies can also be benchmarked, and further research has one large challenge – common benchmark for consultant’s performance, in order to regulate and formalize this industry.

Related to performance measurement in consulting, a huge field of transaction costs, which yielded research of three Nobel-prize winners is also interesting direction. Large fraction of costs services which are hard to specify are transaction costs (Jaško, Jovanović, & Čudanov, 2015) and that fraction does not directly create any value. Two different threads of research can be joined, because regulation and diminishing of opportunism by common formal benchmark standards would diminish transaction costs by theory. It can be concluded that the consulting industry is still evolving, in line with the trends and developments in the global market. Organizations clearly recognize the importance of the assistance they can get from the experts, and in accordance with their ability they decide to use this help in order to improve their business and keep pace with the growing competition.

REFERENCES

Anderson, D. L. (2012). *Organization Development: The Process of Leading Organizational Change.* SAGE Publications, Inc.

Armbrüster, T. (2006). *The economics and sociology of management consulting.* Cambridge University Press.

Baaij, M. (2013). *An Introduction to Management Consultancy.* Sage.

Biech, E. (2011). *The business of consulting: The basics and beyond.* John Wiley & Sons.

Biggs, D. (2010). *Management Consulting: A Guide for Students.* Hampshire: Cengage Learning.

Consultancy.uk. (2016). Retrieved Januar 31, 2016, from Consultancy.uk: www.consultancy.uk

Cropf, R. A. (2008). *American Public Administration: Public Service for the 21st Century.* Pearson Education, Inc.

Florzak, D. (1999). *Successful Independent Consulting: Turn Your Career Experience Into a Consulting Business.* Westmont: Logical Directions, Inc.

Haksever, C., & Render, B. (2013). *Service Management: An Integrated Approach to Supply Chain Management and Operations.* FT Press.

Jaško, O., Čudanov, M., Jevtić, M., & Krivokapić, J. (2013). *Osnovi organizacije i menadžmenta.* Beograd: Fakultet organizacionih nauka.

Jaško, O., Jovanović, P., & Čudanov, M. (2015). Cost Efficiency of Public Procurement at Local Level: Chances for Improvement of Local Self-government and Public Enterprises in Serbia. *Lex Localis, 13*(3), 789-809.

Kipping, M., & Clark, T. (2012). Researching Management Consulting: An Introduction to the Handbook. In M. Kipping, & T. Clark, *The Oxford Handbook of Management Consulting*, 1-28. New York: Oxford University Press.

Kubr, M. (2002). *Management consulting: A guide to the profession.* International Labour Organization .

McKenna, C. D. (2006). *The World's Newest Profession: Management Consulting in the Twentieth Century.* Cambridge: Cambridge University Press.

O'Mahoney, J., & Markham, C. (2013). *Management Consultancy.* Oxford University Press.

Orr, L. M., & Orr, D. J. (2013). *When to Hire or Not Hire a Consultant: Getting Your Money's Worth from Consulting Relationships.* Apress.

Phillips, J. J., Trotter, W. D., & Phillips, P. P. (2015). *Maximizing the Value of Consulting: A Guide for Internal and External Consultants.* Hoboken: John Wiley & Sons, Inc.

Poulfelt, F., Greiner, L., & Bhambri, A. (2010). The Changing Global Consulting Industry. In F. Poulfelt, & L. Greiner, *Management Consulting Today and Tomorrow: Perspectives and Advice from 27 Leading World Experts.* Routledge.

Scott, B. (2003). *Consulting on the Inside: An Internal Consultant's Guide to Living and Working Inside Organizations.* ASTD.

Stryker, S. C. (2011). *Principles and Practices of Professional Consulting.* Plymouth: Government Institutes.

Werr, A., & Linnarsson, H. (2002). Management Consulting for Client Learning: Clients' Perceptions of Learning in Management Consulting. In A. F. Buono, *Developing Knowledge and Value in Management Consulting*, 3-32. IAP.

WetFeet. (2008). *Careers in Management Consulting.* WetFeet, Inc.: San Francisco.

Wright, C., & Kipping, M. (2012). The Engineering Origins of the Consulting Industry and its Long Shadow. In M. Kipping, & T. Clark, *Researching Management Consulting: An Introduction to the Handbook*, 29-50. New York: Oxford University Press.

APPLYING A GENERAL MORPHOLOGICAL ANALYSIS IN LONG-TERM DEFENCE PLANNING PROCESS

Milan Kankaraš*[1], Dejan Stojković[1], Ranko Lojić[2]
[1]Ministry of defence of the Republic of Serbia, Defence Policy Sector, Strategic Planning Department
[2] Ministry of defence of the Republic of Serbia, Human Resources Sector, Military Academy
*Corresponding author, e-mail: kankaras.milan@outlook.com

Abstract: *Long-term defence planning process is of huge importance for defence system development. In the process there are many uncertainties and non-quantifiable issues. Defence planners should assess environment as well as describe possible solutions and scenarios for military force engagement. There is no unique approach to a scenario building as a main tool of long-term defence planning. One of the possible models to identify and describe conditions and solutions is applying a general morphological analysis. This paper presents possible ways of applying a general morphological analysis to solving the problems and solutions as an authors' vision for continuous long-term defence planning process improvement. This paper could be useful for the development of military science, as well as practical solutions for management in public sector organizations and other organizations.*

Keywords*: defence, planning, scenario, general morphological analysis, development*

1. INTRODUCTION

Contemporary organizations operate and achieve their activity in different political, economic, security, social, demographic, technological and other conditions. Dynamic changes in these conditions raise new and complex demands to organization management. Results achieved in a short period of time become obsolete and unusable. The management is faced with the problem of constantly increasing demands of stakeholders, as well as maintaining the quality of general interest activities.

For defence system, as a specific public sector organization, an activity of general interest is the protection of the defence interests. In this regard, the defence system develops capabilities necessary to fulfill that mission..Long-term defence planning process enables determination of necessary capabilities in accordance with political requests, conditions of complex environment and resources constraints.

Defence planners are faced with many different problems in the long-term defence planning process. These problems more often are multi-dimensional and they are not quantifiable. One of the possible modes to solving such problems is applying a general morphological analysis (hereinafter: GMA).

General morphological analysis enables consideration of problems link to parameters and structuring, as well as of multi-dimensional and non-quantifiable issues analysis. Also, GMA enables determination of relationship between their issue parameters and selection of issue parameters based on internal consistency. In long-term defence planning process GMA enables consideration of environment condition parameters and specific parameters of possible force engagement scenarios.

2. LONG-TERM DEFENCE PLANNING

In relation to the time planning period there are three main time horizons: long-term, middle-term and short-term planning (Stojković & Dahl, 2007). In management theory there is no accepted time span for long-term planning period, but usually one considers a time horizon of fife years or more.

Also, in management theory there is no accepted long-term defence planning definition. Long-term defence planning could be defined as „a process that investigates possible future operating environments and develops a force structure development plan to best adapt the defence organization to these environments given a host of constraints – including financial ones" (RTO/NATO, 2003). In other hand, (Stojković & Dahl, 2007) was defined long-term defence planning as „a process of defining long-term defence objectives and a strategy for their fulfillment".

Long-term defence planning relies on many different approaches usually used in complementary not singly way. In his discussion Faber (Faber, 2016) claims there are at least six types of approaches: top-down planning, resources-constrained planning, incremental planning, capability-based planning, scenario-based planning and threat-based planning.

Process of long-term defence planning shown on Figure 1 includes the following phases: political guidance analysis, environment assessment, mission analysis, scenarios development, capability requirements, capability assessment, options development and solution choice (Stojković & Dahl, 2007).

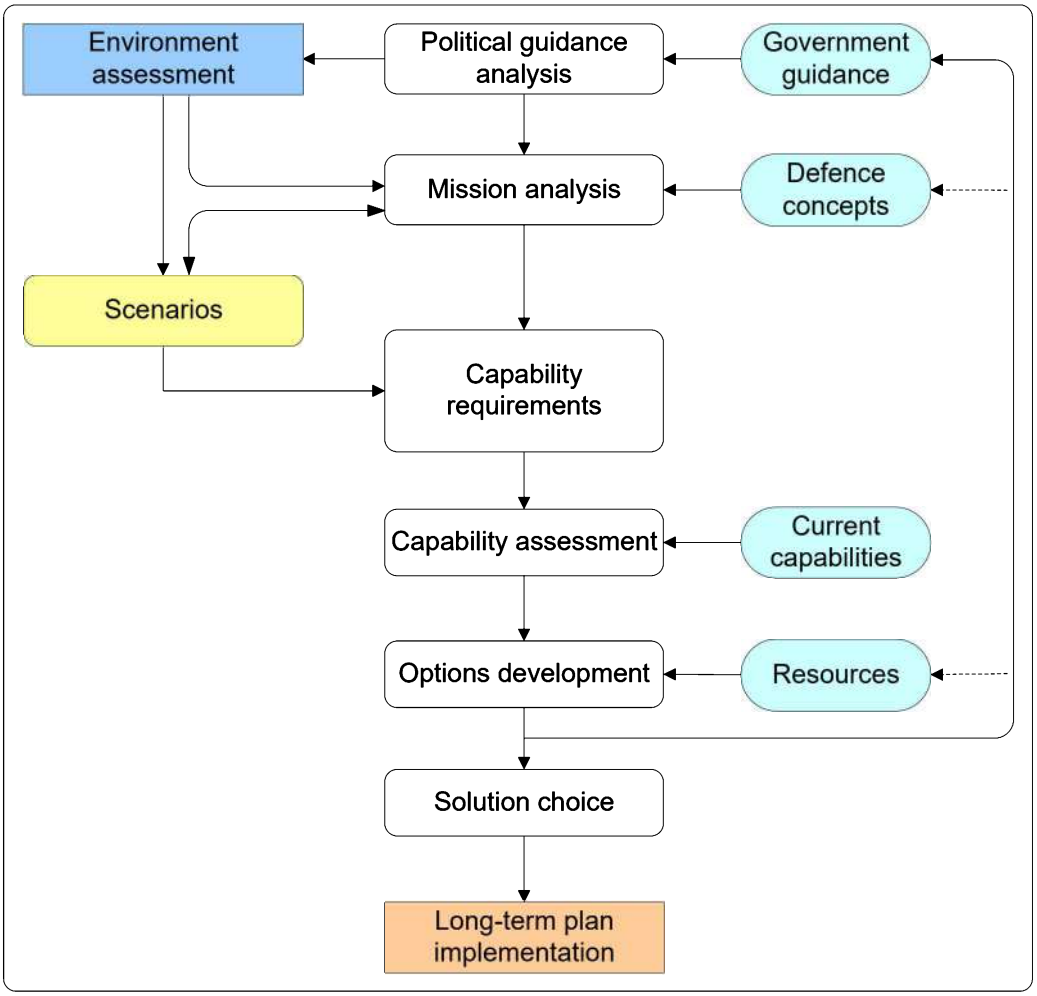


Figure 1: Process of long-term defence planning (Stojković & Dahl, 2007)

The process starts by asking question *what defence system should do.* Answer to this question is given by political guidance analysis. The second stage of this process is environment assessment. In this stage planners need to realize future security, political, economical, social and technological issues.

Mission analysis is the third phase of the long-term defence planning process, and its purpose is to identify what should be done in order to achieve determined political requests. In this stage defence planners identify main missions, their objectives, mission tasks and tasks decomposition. In accordance with the political requests, and based on defence concepts, result of this stage is a task structure.

Scenario development is the next stage in this process, and main end of this stage is a creation of future situation or conditions for military force engagement. Based on possible scenarios defence planners can determine future capabilities as a capability requirements. In accordance with the current capabilities and capability requirements, capability assessment is conducted. Result of capability assessment stage is the capability gaps.

Different modes can be used to solve capability gaps. Defence planners develop different approaches to solve capability gaps, assess feasibility of each approach and define some possible and realistic options. The last stage of long-term defence planning process is a solution choice. Purpose of this stage is to analyse the options and select optimal one. Result of this stage and long-term defence planning process as whole is long-term defence plan.

3. MORPHOLOGICAL ANALYSIS

In the process of long-term defence planning there are many political, social, economical and other factors affects the process, and it is necessary to solve many multi-dimensional problems. One of the available methods is general morphological analysis.

Ritchey (2011) points out that GMA „is a method for systematically structuring and analyzing the total set of relationships contained in multi-dimensional, non-quantifiable problem complexes". The method enables investigation of problem complex by developing a discrete parameter space, and determination of the relationship between the parameters on basis of internal consistency. Such an internally banded parameter space is called a morphological field.

The purpose of GMA is identifying and investigating the total set of possible relationship contained in a problem complex. These possible relationships are called configurations. Determining the configurations is accomplished through two phases of GMA: analysis and synthesis. Bearing in mind the foregoing it is possible to conclude that morphological analysis is a specific process of analysis-sinthesis.

General morphological analysis starts by identifying the most important parameters of the problem complex. In the next step is determination of values or conditions for every determined parameter. In that manner is constructed morphological field (Ritchey, General Morphological Analysis (GMA), 2011). Morphological field represents a set of parameters against each other in order to create an n-dimensional configuration space (Table 1).

Table 1: Morphological field

Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6
Value or condition 1-1	Value or condition 2-1	Value or condition 3-1	Value or condition 4-1	**Value or condition 5-1**	Value or condition 6-1
Value or condition 1-2	**Value or condition 2-2**	**Value or condition 3-2**	Value or condition 4-2	Value or condition 5-2	**Value or condition 6-2**
Value or condition 1-3	Value or condition 2-3	Value or condition 3-3	Value or condition 4-3	Value or condition 5-3	Value or condition 6-3
Value or condition 1-4	Value or condition 2-4		Value or condition 4-4	Value or condition 5-4	Value or condition 6-4
	Value or condition 2-5		**Value or condition 4-5**	Value or condition 5-5	

Every morphological field can contain many possible configurations, and it depends on number parameters and their values or conditions. Number of possible configuration is calculated as product of the number of values or conditions for every parameter. Morphological field in Table 1 contains 6000 possible configurations (4x5x3x5x5x4).

As it is shown, there are many possible configurations. However, there are some inconsistent configurations. Inconsistent configurations are determined in the GMA's next step – cross-consistency assessment (Ritchey, Modeling Alternative Futures with General Morphological Analysis, 2011).In this step all of the parameter values or conditions are compared whit one another. The comparison is realized in a cross-impact matrix (Table 2).

Table 2: Cross-impact matrix (Ritchey, General Morphological Analysis (GMA), 2011)

Parameter	Value or conditions	Parameter 1				Parameter 2				Parameter 3			
		1-1	1-2	1-3	1-4	2-1	2-2	2-3	2-4	2-5	3-1	3-1	3-3
Parameter 1	1-1												
	1-2												
	1-3												
	1-4												

Parameter	Value or conditions	Parameter 1				Parameter 2				Parameter 3			
		1-1	1-2	1-3	1-4	2-1	2-2	2-3	2-4	2-5	3-1	3-1	3-3
Parameter 2	2-1												
	2-2												
	2-3												
	2-4												
	2-5												
Parameter 3	3-1												
	3-2												
	3-3												

In the cross-impact matrix every pair of parameter values or conditions is examined..The purpose of this step is to determine consistent relationship, i.e. the pair can coexist. This purpose is achieved by comparing every parameter value or condition parameter value or condition with another in the morphological field. The judgment is mainly based on morphologists' individual expertise, knowledge and experience. It is necessary to find logical contradictoriness, and take to account empirical and legislative limitation which could relay on some ethical or even political issues.

After pair-wise consistency assessment inconsistent configurations are discarded, and in the morphological field remain only consistent configurations. Using this technique a morphological field can be reduced by more than 90% depending on problem structure. One of the consistent configurations is shown in the Table 1 (the darkened cells).

General morphological analysis is used to solve different multi-dimensional and non-quantifiable problem complexes in contemporary organizations. Also, GMA can be used to solve problems in the process of long-term defence planning especially in scenario development stage.

3. APPLAYING MORPHOLOGICAL ANALYSIS

General morphological analysis can be used for analysis of all kind of complex issues and finding alternative options for the future (Ritchey, Modeling Alternative Futures with General Morphological Analysis, 2011) like:

- developing scenarios and scenario modelling laboratories;
- developing strategy alternatives;
- analyzing risk;
- relating means and ends in complex policy spaces;
- developing models for positional or stakeholder analysis;
- evaluating organizational structures for different tasks;
- presenting highly complex relationships in the form of comprehensible, visual models.

In the process of long-term defence planning there are many uncertainty, multi-dimensional and non-quantifiable problems. They have an effect on all stages in the process, especially on outcome of the process – the long-term plan. As we mentioned before, GMA is one of the solutions for such a problems, especially in two phases of long-term defence planning: environment assessment and scenario development.

During the environment assessment stage defence planners identify future conditions in security, political, economic, social, technological, and other areas of interest. Also, it is necessary to define some possible values or indicators for every area. That requires knowledge and experience, as well as engagement of experts for certain areas.

In this phase GMA can be applied in different ways. One of possible ways enables an equalizing areas and parameters. In this case environment assessment makes a morphological field, and each area becomes a parameter for itself. An example of environment assessment as morphological field is shown in Table 3.

Table 3: Possible environment assessment morphological field

Security area	Political area	Social area	Environment area	Technological area
S-1	P-1	So-1	E-1	T-1
S-2	P-2	So-2	E-2	T-2
S-3	P-3	So-3	E-3	T-3
S-4	P-4	So-4	E-4	T-4
S-5			E-5	T-5

Because of complexity of environment it is necessary to conduct thorough assessment. Other mode of applying GMA enables an equalizing parameters values or conditions and parameters. The area of assessment makes a morphological field. Each value or condition becomes one parameter, and defence planners define value or conditions for every parameter. In this case it would be made five different morphological fields (Table 4).

Table 4: Possible security area morphological field

S-1	S-2	S-3	S-4	S-5
S-1-1	S-2-1	S-3-1	S-4-1	S-5-1
S-1-2	S-2-2	S-3-2	S-4-2	S-5-2
S-1-3	S-2-3	S-3-3	S-4-3	S-5-3
S-1-4	S-2-4	S-3-4	S-4-4	S-5-4
	S-2-5			S-5-5

Possible configurations total set reduction enabled selection of possible environment assessment configurations and description of each area conditions.

More often GMA is used in scenario development phase. This phase enables future consideration of state. Scenario can be defined as a future situations or conditions..It is not prediction or prognostic set of issues rather what could possibly happen. Also, scenario is hypothetical set of situations for military force engagement (Kovač & Stojković, 2009).

Scenario development stage begins with identification of scenario parameters. That parameters should be the best description in details of a possible situations. Later on, every parameter must be fragmented in a number of values or conditions. Joining parameters and values we establish a certain number of configurations. Defence planners should reduce the total set of possible configurations to set of internal consistent configurations in the next step. And last but not least, planners should select possible situations and create some possible scenarios.

Practically, a creation of possible scenarios is similar to GMA procedure. Each scenario represents a possible situation for military forces engagement, and a certain morphological field. Morphological field contains scenario parameters and their values or conditions, and after reduction of total set of possible configurations defence planners can select possible scenarios. An example of scenario as morphological field is shown in
Table 5.

Table 5: Possible scenario morphological field

Scenario parameter 1	Scenario parameter 2	Scenario parameter 3	Scenario parameter 4
1-1	2-1	3-1	4-1
1-2	2-2	3-2	4-2
1-3	2-3	3-3	4-3
1-4		3-4	4-4
1-5		3-5	

As it is shown, GMA can be applied in different ways depending on needs and projected outcomes. General morphological analysis enables solving multi-dimensional and non-quantifiable problems and generates phases of long-term defence planning process. Ministry of Defence of the Republic of Serbia has created software for conduction GMA. Applying the software enables significantly shorter time for GMA conduction and completely reliable products of process.

4. CONCLUSION

Long-term defence planning is very important for defence development and enables determination of future capabilities and risks. In the process defence planners are faced with many uncertainty and non-quantifiable issues. One of the possible modes to solving such problems is applying general morphological analysis.

General morphological analysis enables consideration of problem parameters, structuring and analyzing multi-dimensional and non-quantifiable issues. In long-term defence planning process GMA enables consideration of environment condition parameters and specific parameters of possible force engagement scenarios.

Based on the previous general morphological analysis can be useful for long-term defence planning process and enables achieving different effects:

- consideration of different problems;
- structuring and analyzing multi-dimensional and non-quantifiable problems;
- determination of relationship between problem parameters (possible configurations);
- selection of problem parameters ob basis internal consistency;
- selection of consistent configurations and
- solving problem.

The presented mode of applying GMA may be applied in defence sector, as well as in public sector organizations and other organizations. Application of GMA in other organizations does not require an adjustment, just determination of issues, their parameters and parameter values or conditions. In further, researchers should address the improvement of this method, and its wider application.

REFERENCES

Chermak, T. J. (2011). *Scenario planning in organizations - How to create, use, and assess scenarios.* San Francisco: Berret-Koehler Publishers, Inc.

Clements, J., & Gido, J. (2009). *Effective Project Management.* South-Western Cengage Learning.

Davis, P. (2002). *Analytic Architecture for Capabilities-Based Planning, Mission System Analysis, and Transformation.* RAND MR-1513-OSD.

Department of National Defense, O. (2002). Capability Based planning for the Department of National Defense and the Canadian Forces.

Eriksson, T., & Ritchey, T. (2002). Scenario Development using Computerised Morphological Analysis. *Winchester International OR Conference.* England.

Faber, P. (n.d.). *NATO Long-Term Defense Planning: Implications for the Future.* Retrieved March 23, 2016, from https://www.google.rs/url?sa=t&rct=j&q=&esrc=s&source=web&cd=4&ved=0ahUKEwi1vunK0NbLAhVn_HIKHTmWDPcQFgg6MAM&url=http%3A%2F%2Fmercury.ethz.ch%2Fserviceengine%2FFiles%2FISN%2F26460%2Fipublicationdocument_singledocument%2F117b439b-5ea7-46fb-b116-60f3b25005fe

Kovač, M., & Stojković, D. (2009). *Strategijsko planiranje odbrane.* Belgrade: Vojnoizdavački zavod.

Plauché, M., Waal, A. D., Grover, A. S., & Gumede, T. (Spring 2010). Morphological Analysis: A Method for Selecting ICT Applications in South African Government Service Delivery. *Annenberg School for Communication & Journalism Volume 6, Number 1* , 1-20.

Ritchey, T. (2011). General Morphological Analysis (GMA). In T. Ritchey, *Wicked Problems – Social Messes*, 7-18. Berlin: Springer.

Ritchey, T. (2011). Modeling Alternative Futures with General Morphological Analysis. *World Future Review* , 83-94.

RTO/NATO. (2003). *Handbook on Long Term Defence Planning.* RTO-TR-069.

Stojković, D., & Dahl, B. R. (2007). *Methodology for long term defence planning.* Kjeller: Norwegian Defence Research Establishment (FFI).

Vencel, C. L., & Matthews, D. (2002). *A System Analysis of the DCPG Capability Domain Architecture - Part One: Characteristics of Idealized Domain and Domain Set.* Edinburgh: DSTO Technical Report.

Walker, R. (2002). *Towards Defense Capability Management: A Discussion Paper.*

PROGNOSTIC RESEARCH IN THE FUNCTION OF STRATEGIC DEFENSE PLANNING

Srđan Blagojević*[1], Vladimir Ristić[1], Dragan Bojanić[2]
[1]University of Defence in Belgrade, University of Defence in Belgrade
[2] University of Defence in Belgrade
*Corresponding author, e-mail: srdjan.blagojevic@mod.gov.rs

Abstract: *As the defense and security are some of the most important functions of the political system, jobs in defense planning should be approached cautiously and responsibly. The rapid development processes important segments of human society are calling for the important political action based on the results of strategic planning. This means the necessity of a well-planned in advance of decisions based on the results of modern science. Given that scientific forecast is one of the possible important scientific objectives and the highest level of scientific knowledge, prognostic research deserve an important place and role in creating a defense system based on strategic planning. In the present study, the prognostic role of research in the complex process of strategic defense planning.*

Keywords*: scientific prognosis, prognostic research, defence system development, strategic planning*

1. INTRODUCTION

Strategic defence planning requires the need for the necessary application of prognostic research. Prognostic studies are carried out in various stages of the process with the goal of more efficient planning for defence purposes. They are primarily aimed at anticipating of possible threatening conditions and methods, and ways of circumvention, prevention and reduction of the effects of the attack, which represents a social action to overthrow the state.

Possible sources, forms and processes of compromising modern states are very numerous and varied. Just an estimation is not only enough for their determination, due to the fact that any evaluation represents the most intuitive form of measurement. Therefore, the development of the defence system should not be based on the intuition of individuals and groups of people who are currently in positions of making major political decisions, but exclusively on the strategic defence planning based on prognostic studies.

As such, a reasearch may be exploratory or formulative, descriptive, diagnostic or hypothesis testing, etc. In Saho (2003) opinion „research can be oriented to explore new things or new solutions and new insights in a particular phenomenon. This type of research can lead to the formulation of new things.“ Scientific prognostic represents one of the possible important scientific objectives and the highest level of scientific knowledge. A research think she prognostic studies that aim to predict future events based on known parameters. (P.3). Well known forecasters in the field of social sciences are Huntington Fukuyama and Brzezinski. Prognostic research are different from other types of research, in two important characteristics. The first one concerns on their case studies that can represent not only likely but also possible, and preferred future events. Another characteristic is reflected in the need to present a complete holistically view of the current reality and its impact on future events.

In our deliberations, we will not deal with the problems of research projecting. Our presentation will refer to the importance of these research in the complex process of strategic defence planning and emphasizing the necessity of application of their results in the development of defence plans.

2. THE CONCEPT AND IMPORTANCE OF STRATEGIC DEFENSE PLANNING

In order to adequately explain the concept and importance of strategic defence planning, it is necessary at the beginning, to dedicate a little attention to the importance of planning in general. Shortly, planning is the process of making decisions about the organization's goals and strategies for their implementation. It is connected with all the other functions of managing the organization, and performance of all other functions is conditioned by the planning. Danilovic N, Gordic M. and S. Blagojevic (2015) considered that "the strategic defence concept is determined with basic human and material resources in society and developed to a comprehensive and complex system of defence" (p 145).

Defence is an organized counter action in terms of thwarting, preventing and reducing effects of the attack which is the social action to overthrow the state. The final result of planning should be a defence system that is tailored to the needs and capabilities of the state, and which is able to contribute to the protection of vital national interests.

Based on the mentioned, we can conclude that the defence planning represents continuous control activity and specific planning discipline, which is implemented by the state administration and the armed forces in the area of defence. As part of this activity, targets are determined, subjects - holders of certain activities are established, as well as ways how to achieve these goals. Therefore, defence planning includes the development of a number of concepts, strategies, plans and subplans which are necessary for the implementation of the process of harmonization of policies and the system of defence, and for the coordination and integration of activities and actions that are in the responsibility of the defence system.

According to Davis (1993), defence planning in a broader sense include: strategic planning, operational planning and planning of deployment. (P.3.). Such clasification is conditional, and it is made according to the nature of the problem which is solved through the process of planning and the decisions made meanwhile.

Strategic planning is a part of defence planning in which the competent national authorities through the highest level documents, determine the strategic objectives in the field of defence and establish ways of their realization. Strategic planning aims to ensure compliance of state of the defence system with its environment, and to allow the defence system to rationally and timely react to the changes in the environment. The outcomes of strategic planning are: national security strategy, defense strategy, military strategy, Strategic Defence Review, the long-term plan for the development of the defence system and the like.

Operational planning is a part of defence planning where strategic orientations are translated into concrete activities to achieve certain results, and strategic goals are implemented and the tasks of the defence system are carried out. Within operational planning, strategic goals of the defence system are associated with the resources necessary for their realization. The outcomes of operational planning are: medium-term plans and programs of development of the defence system, the instructions for making medium-term plans and programs, ministerial guidance, financial and other plans, etc.

As with business planning, strategic and operational planning of defence are closely linked and interdependent. The operational planning comes from the strategic planning of defence, in the sense that the strategic destinations of the defense system are concretized and operationalized through it. On the other hand, strategic defence planning precedes, or knowingly includes operational planning activities that will demonstrate the validity of the strategic ideas.

Planning the use of force is a specific part of defence planning which determines the mode of operation of the armed forces and other defence forces, in order to achieve the stated objectives in war and emergency. Within planning the use of forces, the obligations and duties of all subjects of defence in terms of organization and preparation of forces, resources and procedures in war and emergency, or crisis, are defined. The outcomes of the planning process of deployment are: plan of use of the armed forces, mobilization plan, a plan of engagement of the state organs and the like.

3. LONG-TERM DEFENSE PLANNING

In our work we accept thinking of Tagar (2015), who is considering a long-term defense planning a time horizon of 10-30 years (p.9). Do the fact that long-term plans in many countries, both NATO members and partners, as well as in other countries is considered a time period longer than 10 years, has led us to this commitment.

Long-term planning of development of the defence system is one of the important factors of strategic defence planning, which has a significant impact on the future efficiency and effectiveness of the defence system. It aims to ensure that the defence system possesses the necessary power and resources, or the ability to execute future missions and tasks. It is oriented toward the relatively distant future. Therefore, in the process of long-term planning, we are facing with the numerous difficulties which are the result of uncertainty and ambiguity in the future. In the opinion of Kovac and Stojkovic (2009) "The uncertainty and ambiguity pose a major challenge for planners in the defence system, as well as for policy makers." (P.425).

Long-term planning of development of the defence system is an interdisciplinary process that includes a number of interdependent but different actions and activities. In their implementation, a lot of adjustments and reconciliation between political and military elite, planners, military commanders and other subjects of the defence system are required.

In the NATO publication "Handbook for long-term defense planning" (2003), long-term planning of development is defined as "a process that considers the future operating environment, and create a plan for the development of force structure for optimal adjustment of the organization of the defence system to that environment, considering the constraints, including financial ". (P.3.). Thus defined, the term indicates that the purpose of long-term development planning is a model of the defence system, that will be developed based on identified needs and available resources, on the basis of precision tailored plans of development.

Long-term planning of development of the defence system is a complex process that first predicts the possible future environment and then create a plan of development so that the defence system could in the best way adapt to that environment, regardless of the existing and possible limitations (normative constraints, resource constraints, financial and other constraints) . Based on the above facts, the long-term development planning of the defence system can be briefly defined as the process of determining the long-term development goals of the defence system and strategies to achieve them.

Stojkovic and Dahl (2007) considered that "Long term defense planning is never just a technical procedure. It is also a highly political process that needs to be discussed in political terms (i.e., good and continual dialogue must exist between long-term planners and policy makers). At the same time, if care is not taken to Ensure objectivity and LTDP, it risks being dismissed as a politically biased process. (P.31.)". It is important to emphasize the importance of the dialogue approach to research because it is a matter of effective communication of all relevant stakeholders who are interested in the process of defense planning. It includes external stakeholders, ie the entire public that is sensitive regarding questions of security and defense. In the opinion of Flyvbjerg (2012) "Highly specialized media such as scientific journals and monographs are suitable for addressing academic audiences. But they are utterly inadequate when we need to reach out to groups that are relevant in the practical world of politics, administration and planning. Public dialogue that includes communication through daily media is necessary (p.214)".

4. THE PLACE AND ROLE OF PROGNOSTIC RESEARCH IN CERTAIN PHASES OF THE PROCESS OF LONG-TERM PLANNING OF THE DEFENCE SYSTEM

The process of long-term planning of development of the defence system essentially consists of the following essential phases, namely:

1. Harmonization and coordination of political and defence objectives,
2. Adoption and consideration of policy guidelines,
3. Analysis of the security environment,
4. Analysis of the missions,
5. Anticipating changes in the security environment,
6. Development of possible scenarios,
7. Determination of the necessary abilities,
8. Determining the difference between the required and actual abilities,
9. Developing options and
10. The choice of solutions.

In each of these mentioned phases, subjects of alignment of the politics and the defence system fulfil their important role. In our case, political and military leaders can be considered as subjects. With due respect to the above facts, we can conclude that the long-term planning of the defence system according to this model, represents a dynamic social and political process in which the degree of compliance depends not only on the general social and political circumstances, but also on the capacity and personal prestige and influence of the military and political leaders. Attitudes based on experience, professional knowledge, but also on valuable scientific prognosis can raise the credibility of military elites, which are not in an equal position in this process.

In any political process, and therefore in the long-term defense planning, political behavior occupies an important role. In this regard, Blakvel (2003) argues that "political behavior can and must be scientifically studied, especially by quantitative method", in order to plan future actions based on empirical data (p.44.).That is why, a great attention is given to researching global strategic trends for a longer period, by modern armies of the world. A typical example is the research conducted by the British Ministry of Defence. The results of a recent survey which aimed to provide a strategic context to identify long-term threats and opportunities by 2045, was published the fifth edition of the publication Global strategic trend GST (2014). It was pointed out that the aim of their research was not to predict the future. Instead, it describes those phenomena that can have a significant impact on the future and combines different perspectives to create multiple image possible outcomes. "Global Strategic Trends (GST) describe a broader strategic context aimed at those in the Ministry of Defence (MoD), the Government and beyond, who are involved in the development of long-term plans, policies and capabilities. Without this strategic context, there is a risk that planners, policy makers and creators of the development capabilities assume the future based on already preconceived thoughts and assumptions. "(P.3.). Of course, an important role in this process is communication with the public and the timely and adequate information, and information operations doctrine in which Great Britain has a hundred years of experience. Principles and concrete examples of British news operations described in his work Richard L. (2015) with special end view on the current experiment Rainbow in the dark (41-66).

In the view of Termiz (2014) "security activities are specific activities, so their research also necessarily occur as research into specific conditions, and the methodology of their research as a special methodology applied" (p.96.). Results of the prognostic research should be considered in each of the preceding phase of long-term planning, but their significance is particularly highlighted in certain phases. In our further work, we will make special reference to only those phases where scientific prognosis has highlighted character.

5. PREDICTION OF CHANGES IN THE SECURITY ENVIRONMENT

Consideration of policy approaches to their own and other countries, the analysis of the current security environment, as well as historical trends and events must precede the quality prediction of possible changes in the security environment. Basic entering at this phase are the analysis of national interests and objectives, strategy of national security, the defence strategy of potential opponents and allies, their future role, the role of international organizations and alliances and more.

The first step involves a detailed study of the basic documents relating to national security, defence and foreign affairs to determine the political intentions of other countries, as well as the political implications on the defence system. Thus, the results of this phase are forecasts of the political ambitions of neighboring countries and the important countries on the world political scene, as well as their political priorities in the field of defence. We are often faced with the fact that in the available documents of many countries all the security and defense objectives and interests are not explicitly formulated, and the key role of prognostic research at this stage is that they are timely detected.

By this, we can identify national interests, which can be influenced by future events, developments and trends in the security environment.

In order to reach a good prognosis, it is necessary to carry out the four important steps:

- collect the necessary data,
- analysis, sorting and processing of data,
- identification of opportunities, risks and threats and
- prognosis of the required number of strategic situations.

In the first step, the data needed for further work on the prognosis of the future environment is collected. Of particular importance are the data relating to future security, political, economic and social issues, as well as the technological development and the environment. Data sources can be different, from the intelligence services to scientific institutions.

The second step requires a good understanding of scientific methodology, analytical knowledge and experience. To obtain reliable results. Subjects of the development of the defence system can use the services of methodologists and other scientists trained in the application of scientific methods in the fields of politics, economy, technology, defence, security, etc.

In the third step, the results of the analysis are used for the consideration of the future impact of environment on the national interests and objectives. At this stage, the aim is to identify future opportunities, but also risks and threats to national interests and objectives.

The final step in forecasting future security environment is the development of an adequate number of possible strategic situations which represent future developments of events in various fields.

6. THE ROLE OF PROGNOSTIC RESEARCH IN DEVELOPING OPTIONS AND SELECTING SOLUTIONS

The development of options and choice of solutions represent some of the last phases of a long-term development planning of the defence system in which prognostic researchs can achieve an extremely important role. At this phase, we determine the possible approaches for overcoming or reducing the difference between the required and existing abilities that have been identified in the previous phase of the planning process. Therefore, it is extremely important that in previous phases, scientific prognosis has produced good results. If the prognosis were incorrect, it is likely that they will develop a wrong option, e some of the bad solutions can be chosen, which can have unforeseeable consequences for the system of defence of the country.

Basic enters in this phase of the planning process are the differences in capabilities and available resources, while the basic result of the realization of this phase is a list of potential options based on resources. The results of prognostic research at this phase should answer the question of whether changes in capacity factors (doctrine, organization, training, leadership, human resources, etc.) and / or operating concepts can overcome the established difference in the ability of the existing defence system that needs to be achieved in order to provide defence system ability respond to future threats.

The development of more realistic options is an essential step in overcoming the differences between existing and required abilities. One of the most complex issues in the course of scientific prognosis is obtaining the realistic costs, particularly for options that include a long-term period of time or involving development of new abilities. Prognosis of costs should be precise and comprehensive in order to enable comparison of different options and a selection of the most suitable.

The result of the previous phase of long-term development of the defence system is a list of options for resolving differences between existing and required abilities. The purpose of the last phase of the process of long-term development planning is the selection of an appropriate solution. The first step in this phase involves consideration of options for every difference in abilities. If the options do not allow overcoming the differences, defence planners will describe the potential risk. Options that allow overcoming the differences will be tested in order to choose the one that is optimal. The test will be a combination of cost-benefit analysis and risk analysis. Finally, the selected option for overcoming the differences in capabilities and the risks will be included in long-term planning documents relating to the development of the defence system.

7. CONCLUSION

In practice, it happens very often that short-term views dominate, when considering issues related to defence, They are based on a superficial analysis of the challenges and threats to security, the costs of the defence system, and the superficial assessments of subjects currently in the role of decision makers. In such situations, the argument that if there is no risk, there is no need to invest in defense, dominates. However, experience shows that the strategic situation could change relatively quickly while much more time and resources are needed to build defense capabilities. In order to avoid this, it is essential that the development of the defence system is based on long-term planning and long-term planning should be based on quality planned and implemented prognostic research.

Given that the activities of the security system, and thus the defence system as its important subsystem, are preventing and disabling systematic and permanent threat to individuals and society, we agree with the opinion of Professor Termiz that defence activity essentially consists of two major components: research and taking measures of intervention.

We particularly emphasize the importance of scientific research because the facts speak in favour of that many long-term development plans were not realized, respectively they were not of much use for defence systems in a changing and uncertain environment, just because that during the planning process the

scientific method was not applied and the results of the planning were not based on the principles of the methodology of scientific research.

Long-term planning of development of the defence system, based on scientific prediction of future risks, increase the likelihood of achieving political and defense objectives. Also, long-term planning based on prognostic research improves understanding of the strengths and weaknesses of the defence system to operate in a changing environment. By using valid scientific prognosis, we create conditions for careful consideration of the abilities of the defence system and the allocation of resources, which is based on the priorities. Also, long-term planning establishes a connection with the long-term financial and political challenges.

Such an approach provides the State an opportunity of dealing with all security needs and problems in a coherent, comprehensive and reliable way. The development of the defense system based on prognostic research represents a pledge for the future in an ever changing world, because it is the long-term investment that we need to keep alive our freedom of action, to defend our values and to preserve our liberties

All these reasons indicate the need of each country to develop its long-term development planning model defense system that is tailored to its needs. Important subject of this model are certainly people in the vocation and science, who are specialized for solving technical and scientific problems. It is therefore important that in this complex process, in addition to participation of the political and military leaders, there is also participation of the experts in certain fields, and the group of experts. Also there is need for participation of the entire institutes that are dedicated to the realization of the defence studies but also other institutes that perform all other scientific studies that can and are used for defense and security. This prevents the political elite to make important political decisions alone and without access to the findings of science and vocation, which may be fatal, both for the security of states and regions, and for the security of all humanity. Only valid prognostic based on the application of the scientific method ensures the proper development of the system of defense and security and the achievement of its important social role.

REFERENCES

Agricultural Science, Social science and other related fields, DOI 10.1007/978-81-322-1020-7_1 Springer Indija 2013.

Blackwel Basil, *Encyclopedia of political thought*, Zagreb, 2003.

Danilović Nedjo, Gordić Miodrag, Blagojević Srđan, *Savremeni sistemi bezbednosti*, Beograd 2015.

Davis Paul, Finch Lou, *Defence planning for Post-Cold War Era*, RAND, USA,1993;

Flyvbjerg Bent, *Making social science matter*, Cambridge University Press, 2012.

ForcePlanning http://se1.isn.ch/serviceengine/FileContent?serviceID=DCAF&fileid=89D6AEE6-2143-771A-D2B5-FEF9879A202B&lng=en. (15.05.2015.)

Kovač Mitar, Stojković Dejan, *Strategijsko planiranje odbrane*, Beograd, 2009.

Richard Lee, *The Rainbow in the dark: Assessing a century of british military information operation*, Defence strategic comunication, NATO strategic comunication centre of excellence, 41-66. 2015.

RTO/NATO: *Handbook on Long Term Defence Planning*, RTO-TR-069, 2003.

Sahu Pradip Kumar, *Research Metodology: A Guide for Researchers in* Global Strategic Trends- Out-2045, Fifth edition, MoD GB, London, 2014.

Stojković Dejan, Bjorn Robert Dahal, *Metodology for Long Term Defence Planning*, Norwegian Defence Research Establishment FFI, 2007.

Tagarev, T., *Integrated Defence Planning: From National Security Policy to*

Termiz Dževad, *Specifičnosti metodologije istraživanja u bezbjednosnoj djelatnosti*, Sarajevo 2014.

ON METHODOLOGICAL APPROACHES TO DEFENCE SECTOR REFORM

Nebojsa Nikolic
Strategic Research Institute, Ministry of Defence
e-mail: nebojsa2008_g@yahoo.com

Abstract: *Public sector reform became a permanent challenge in many countries and subject of studies for many researchers. At the same time it attracts attention of business companies who have interest in doing business with the public sector. Specific part of the public sector is the defence branch -that is Ministry of Defence and Armed Forces. Reforming organizations that are large, specific, complex and hierarchically organized as the military, is a big challenge. Besides defence reform is clearly a unique process –specific for each country and each epoch, it could be very useful to know experiences of different countries. This paper presents few examples of defence reform efforts. From the research point of view, one of the most interesting findings are similarities in problems identified in different armed forces, as well as a general methodological approach applied in the reform process..*

Keywords*: defence, military, organization, reform, transformation, management*

1. INTRODUCTION

Reforms in public sector administration are an actual issue in many countries today. In spite of the opinion that the problem of public sector reforms exists mainly in transitional societies, it is present in developed and stable countries, as well. Due to the size, structure and associated functions to the public sector organization, reform plans and actions are characterized by complexity, uncertainty and continuance. Reforms in public sector produce and induce many direct and indirect consequences (financial, economic, social, political, psychological, technical, organizational, etc), and that is additional reason for comprehensive designing, balanced planning, sensitive corrections and agile remaining on the main course of the reform.

This paper deals with approaches to the reform process in the defence branch (ministry of defence and armed forces) as a part of the public sector. Lessons learned and experience gained from the reforms of the defence sector and military transformations process in foreign countries (like those presented by Catignani (2004), Leslie (2011), Peever (2014), and domestic as well) could be helpful for future reform's endeavors as well as for other public sector branches. In the military context, transparency and the exchange of knowledge and experiences at the international level have become usual activity and applied even by the biggest ones and considered as the most advanced military organizations. It is particularly the case regarding some specific reform questions that modern militaries face today, like issues on the following topics: reserve forces, Keene (2015), Sedivy (2013); wartime army structure and composition, Petrovic (2007); funding questions, Alock (2014); motivation for military service, Taylor et all (2015), Wiggins et all (2014), Nikolic (2015); suspension of conscription system Szvircsev (2014), and so on.

Due to characteristics of security sector and defence branch particularly, special care is added to the comprehensive defence reforms. The term "Defence reform" is related to all reform process and activities undertaken towards changing the two essential components: (1) structure, functions and processes inside the ministry of defence administration including all its underling organizations and units; and (2) all changes of the military units and commands in the armed forces, including changes of missions, doctrines. From the aspect of the Management Science, there are many possibilities and challenging opportunities for inventive application and use of different methods and tools from the organizational sciences. Problem structuring methods is useful for setting clear perception of actual situation as well as for creating reasonable vision of the desired end state. Strategic decision making contributes to producing sound and realistic strategic documents with clear and sustainable relations among fundamental ends (goals), available means (resources) and possible ways (methods). Application of multi-criteria decision making methods and other sub-disciplines of the Operational Research are almost regular in considering organizational challenges in the military branch and defence business. Problem of creating appropriate organizational design, Anand and Daft (2007), continues to occupy researchers and managers in the field of defence and military issues besides other branches in the ongoing epoch, Miles et all (2010).

2. APPROACHES TO DEFENCE REFORM

It could be identified more different methodological approaches to the defence reform process. Reforms itself could be caused by different sources: political decisions, changes in strategic environment, changes in orientation in external politics, alliances, social changes, canceling conscription, economical-financial pressure, technological change-modernization, downsizing, reduction, etc.). Organizational entity that could be tasked to prepare and conduct transformational change in defence organization (perpetrator) could be composed in various ways: interdepartmental working groups, transformation teams or commands, external agent-consultation companies, external top-managers, etc. Fields of change can be different: security perceptions and reevaluations; budgeting system reform; transformation of organizational structure; advancement for military capabilities; improvements of acquisitions processes, etc. Here, it will be presented three examples of methodological approach related to the very beginning of the reform that is, determining the entity those who will create the reform agenda:

- Reform entity is an interdepartmental working group composed from representatives of internal organizational units from the Ministry of Defence (MoD) and armed forces, but possibly open to external experts.
- Main reform entity is an internal organization of the Ministry of Defence or of the armed forces which already deals with a long term organizational development (known also as Transformation command, in some armed forces).
- Reform entity is some external organization or a team of external experts (external means not MoD and not armed forces members).

2.1. Interdepartmental Teams in Defence Reform

Methodological approach marked here as “Interdepartmental Teams in Defence Reform” means that some interdepartmental groups are formed and tasked to analyze situations and make proposals for changes. Members of the teams come from different departments of the ministry of defence (MoD) as well as form different military units including the highest commands.

In the Serbian case there has been created “Defence Reform Group Serbia-NATO” (DRG) in 2006, with a general mission to provide advice and assistance to the state’s authorities towards implementation of modern reforms in a defence sector. Use of “DRG” mechanism was additionally supported after December 2006 when Serbia has joined the Partnership for Peace programme (PfP). DRG was established with intention to contribute to the following goals: to support and accelerate then ongoing reform of the military forces; to advance and promote cooperation and communication among departments; to stimulate project-oriented approach in reform; to effectively use foreign experiences; and to prepare participation in the “Partnership for Peace” program. DRG’s teams were complex and layered, with international and political leaders at the top of the group structure. At the lower level there were numerous specialized interdepartmental working groups entitled as “Working Tables” (WT) which were dedicated to some narrow problems already identified.

The Defence Reform Group in 2006 was consisted of 16 different working teams formed on temporary bases with participants from different departments and organizations from MoD and military units and commands. Those teams were called “Working Tables” (ISAC Fund, 2006) and each of them had gotten titles and numerical codes, as it is presented in Table 1, column two. In order to have better insight in the general orientation of each of those 16 working teams, column one in Table 1 presents general subjects to whom some specific working team is dedicated.

Table 1: Working Tables in DRG Serbia-NATO 2006

Topic	Working Table
Defence policy	WT-6 -“Drafting a Presentation document for PFP”
	WT-7 -“Development of system for effective and efficient defence planning”
	WT-1 -“Development of procedures for defence cost and analysis”
Intelligence and security	WT-13 -“Democratic control and reform of intelligence and security system”
Human resources management	WT-2 -“Development of system for human resources management”
	WT-8 -“Making a project of military professionalization”
Military education and training	WT-3 -“Reform of military education system”
	WT-14 -“Reform of the military training system”
Capability	WT-12 -“Development of mid-term and long-term equipping plans”

development	WT-15 -"Development of command and communication systems"
	WT-16 -"Development of system for emergency management"
Civil-military issues and public relations	WT-4 -"Development of public relation strategy"
	WT-9 -"Development of civil-military cooperation"
Defence infrastructure	WT-5 -"Military bases conversion"
	WT-10 -"Development a model for housing issues"
	WT-11 -"Conversion of military material"

Main topics of all "Working Tables" were very different and covered very broad scope of issues and problems: from public relation strategy, across military training and education, towards human resources management and military infrastructure conversion. Output results and achievements of all groups had been different and specific according to the difference of the main subjects. Similarities among working groups were mainly of methodological nature: teams were composed in a similar way, with similar tasks and mandates, with almost the same main deadlines and with similar general structure of the report which had to be offered to higher authorities. This kind of approach to the reform process contributed without a doubt that decision making at the strategic level became more informed. Also, DRG contribute to the exchange of ideas, information, customs and other, among different departments with accompanying relaxation spirit, which is immanent to the horizontal level of hierarchies.

Besides DRG type of working teams, there are other kinds of working groups as well. Those are formed on a temporary base and dedicated to some specific issues, like: managing emergency situation, drafting proposals for new normative and strategic documents, issues connected to the international military and defence cooperation in some specific fields (European integration, professional military education, emergency management, gender issues, organizational development, terminology unification, standardization, language training, interoperability issues, etc). As military reforms and transformations are almost a constant in many countries, so the research efforts are always actual (Clarke, 2013) and similar modes of engagement are possible in the future. Due to the specificity of the defence and the military issues compared to other public services, there are a lot of opportunities for exchange of experience at an international level. Particularly in regard of transformational process flow, empowered organizational authorities that lead the change, chose among approaches towards organizational transformation, issues of resourcing, measuring of the change progress, etc.

2.2. Internal Transformation Team Approach

Internal transformation team approach is the case when leading members of the team come from an internal organizational entity that is dedicated to transformational and organizational developments of the MoD and armed forces. In favor of this approach is a logical expectation that professionals that already have worked for MoD and armed forces for a respective number of years and having respectable experience gained from different appointments will have enough knowledge about missions, visions, organizational structures, problems, limitations, possibilities and opportunities for MoD and armed forces. Also, it is expected that those "insiders" will have a wide perspective of possible options for organizational change.

On the other side, weakness of this approach (Internal transformation team) in general, could be: unbalanced approach to reform changes (preference towards one organizational unit against other ones); induced resistance to change efforts offered by other organizations; lack of authoritative power, questionable transparency; possibility to be impacted by superior command; lack of the sense of the role and place of the organization in a wider context of the state and society; etc. This approach has huge potential for both general cases: positive and negative. On one hand, referential knowledge about the system under study may offer excellent proposals for relevant changes. On the other hand, fear of consequences and unfair over-control from superiors might produce only false picture of the current state (which has to be, of course, almost ideal) and illusive proposals for "transformation".

This approach could be ilustrated by the recent efforts in Canadian defence structures towards undertaking reform of the military and defence system. In the Canadian case there were more transformation and reform cycles in the longer period. Here it will be presented, in short, only the last one known as the „Report on Transfromation 2011". Transformation team for Canadian Forces (CF) and the Department of National Defence (DND) was established in 2010 and was consisted of military and civilian professionals and was lead by highly ranked general Andrew Leslie (a respected and experienced soldier with impresive professional biography). The team worked hard and in the summer of 2011 they released a comprehensive, evidence based detailed analysis of the current state and main problems as well as detailed proposal for transformation of the CF and DND. Their proposal actally consisted of 43 detailed suggestions and measures that sholud be taken in order to conduct a real transformation. However, it seems that this report

on transformation was too radical for the taste of some stakeholders, and somehow, by the end of the year (2011) the leader of the transformation team has been retired.

Findings of the Transformation Report showed that defence budget has a growth of 51% over the period from 2006 to 2010. Having in mind that was a period of intensive military deployment abroad (Afganistan, Iraq, etc), defence budget enlragement is a logical consequence. However, growth rate was not the same for the whole defence structure institutions. For example, inside a total defence personnel growth of 18%, distribution of personnel growth for different categories was variabile (and surprising):

- Regular force grow was 11%, reserve force growth was 23%, while growth of civilians in defence organization was even 33%.
- Operational units growth was 10%, senior executive growth was 25%, while Headquartiers and Static jobs growth was even 40%.

Those numbers ilustrate a surprising direction of organizational growth for a defence organization that is put in a state of a high level of military engagement at a distant area and hostile environment. Main conclusion of the report was that „teets" (meaning units and resources for engagement at the operational level –at the area of engagement) have to be strenghten instead of strenghting the „tail" (backward organizations and supporting elements of the defence organization).

Sharp, but clear and effective approach that was profiled by the Report on Transformation 2011, made an influence on many stkeholders and wider community. Notwithstanding that the leader of the transformation team was retired, it is recognized that serious changes are needed. As a result, in 2013 it was issued a new document related to the transformation issues but under the new name: Defence Renewal Charter. It was a joint institutional product of the Department of National Defence (the same as MoD) and the Canadian Armed Forces, DoD&CAF (2013). In spite of some contraversials and discusions initiated after the issuing this transformational document, later events confirm that many findings of the Report on Transformation 2011 were valid and found its way towards implementation. According to De Kerckhove (2015), in the following years after famous Report (2011), 35% of the Reports' recommendations have been implemented while another 35% are still considered for future implementations and remaining 30% were rejected.

2.3. External Experts Team in Defence Reform

In some cases of the reforms of the national defence system external expertize was used. Under term "external expertize" it is considered engagement of some external (out of the ministries of defence and out of armed forces) resources that have credible and appropriate level and capacity to enable proposals for reforms of defence system. Entity that will provide external expertize may appear in different forms:

- Expert teams formed on temporary base and consisting of outstanding professionals in their fields (managers, businessmen, university professors, consultants, prominent public servants, statesmen, etc.). They may be domestic, international or mixed. Usually, teams are interdisciplinary.
- External expert support could be provided as well, as a contractual service. In this case, Ministry of defence does hire by contract a consultation agency in order to make a professional and an unbiased plan for performing defence reform.

Each of these approaches to obtaining external expertize for defence reform have pro and con aspects. Which way is better often depends on many factors. Above all, main problems that external team may be faced with are the following: a referential knowledge about system under study (Ministry of defence and the armed forces), its purpose, mandate, organizational structure, operational and functional procedures, as well as strengths and weakness, bottlenecks, etc. However, external experts' team has to be clearly informed about organizational strategical vision and what is a desired state in a prospective future, as well as what are available resources, limitations and time to achieve desired end state.

The main contemporary document for the defence sector reform in Australia was released by the Department of Defence (DoD) on April 2015. This document was commissioned in August 2014, when Minister of Defence has engaged a team of external experts (called the Review Team). Those experts were already well-known and proved in their fields of expertise and willing to make their contribution to the public service. Their task was to scan the situation in defence sector, to identify problems and make proposals for solutions in order to answer the main question: is the Defence ready to fit its mission defined by its strategy in an efficient way. The Review Team has done its task and offered a document entitled "The First Principle Review: Creating One Defence".

The members of the Review Team were all recognized experts and managers with very respective experience and achievements in different organizations and branches. Chairman of the team was David

Peever, former managing director of famous multinational mining company Rio Tinto and has a number of other high appointments in business, industry, academia and society. The team members were also respective experts: Peter Leahy is former Army general with 37-year military career, and Director of the University of Canberra's National Security Institute; Jim McDowell has been Deputy Chair of Australian Nuclear Science & Technology Organization, and Chief Executive in a defence industry company (famous BAE Systems); Robert Hill was a minister in a few mandates in different branches including DoD, and barrister and solicitor before entering politics; Lindsay Tanner is a professor at Victoria University, special adviser in a financial consultancy company, former minister of finance and member of parliament.

This team made extensive work including wide circle of consultation with relevant subjects (parliament, government agencies and departments, military, academia, society, foreign experts, industry and union, and a number of public hearing) for defence issues, and they precisely reported about those consultation in their final document. General findings of the team are expressed through a short list of dominant principles that should be followed by the DoD and ADF in the upcoming reform and future work (Peever, 2014):

- Clear authorities and accountabilities aligned with resources
- Outcome orientation (making results that are required and relevant to the Defence)
- Simplicity (eliminating complicated and unnecessary structures, processes, systems and tools)
- Focus on core business (doing only for itself what no one else can do more effectively and efficiently)
- Professionalism (committed people with right skills in appropriate jobs)
- Timely, constable advice (professional support to decision makers)
- Transparency (honest and open behavior enables insight in what the Defence is doing and why).

Besides above general principles and other findings, the team has offered a list of a seventy detailed and more concrete proposals for making the reform. Also, this transformation document offered a data about growth of senior leadership, similarly as in the Canadian case, but for a different time frame (it was compared following years: 1998 and 2014). The document states that the growth of a senior military leadership including generals was 75-80%, while all other (lower) ranks growth was only 3%. Level of growth of a senior civilians in defence sector was 86-108%, while all other lower positioned civilian growth was 18%. In spite of evident domination of the growth in senior positions, the document does not prefere quatification in advance for „Teeth-to-Tail" ratio, but suggests carefull analysis. It will be interesting to follow future reports about the level of realization of a given transformational proposal as well as about associated implementation problems and obstacles.

3. CONCLUSION

Defence sector reforms are a specific but an important part of the public sector reforms in general. Experiences from reforms of military organization as a highly organized and very complex entity may be useful in considering reform efforts in other branches of public sector. Also, reform experiences and lessons learned from different countries could be very useful in profiling our own reform process. According to up-to-date findings from defence reforms efforts in presented countries, it could be concluded that the sharp cuts and huge changes in a short time are not probable to be completely successful. But, success in defence reform could be expected in a longer period with detailed, comprehensive and resilient planning and engagement of an dedicated reform team with associated mandate for doing reform.

Future research will be related on analyzing reports about ongoing defence reforms in presented countries, as well as in some other states. Besides the issues on reform content and reform team composition, of particular research importance will be methodological questions and issues related to gathering, analyzing and using of data of different kind and types but related to defence and military organization.

Acknowledgement: This work was partially supported by the Ministry of Education and Science of the Republic of Serbia under Interdisciplinary Project No.III-47029 (Project title: "Cost Effective Selection of New Technologies and Concepts of Defence Through Social Reforms and Strategic Orientations of Serbia in 21st Century).

REFERENCES

Alock, S., Greenhalgh, K., Taylor, L., Murphy, P. (2014). Who Pays for Gareth? Relyung on Reservists: The UK Government's Strategic Defence and Security Review. The Journal of Finance and Management in Public Services, 14(1), Retrieved from: http://www.cipfa.org/policy-and-guidance/the-journal-of-finance-and-management-in-public-services

Anand, D., Daft, R. (2007). What is the Right Organization Design? *Organizational Dynamics*, 36/4, 329-344.

Catignani, S. (2004). Israeli Defence Forces Organizational Changes in an Era of Budgetary Cutbacks. *RUSI Journal,* 149(5), 72-76.
Clarke, J. (2013). Europe's Armed Forces in Civil Security. *Connections: The Quarterly Journal,* 12(2), 69-82. Retrieved from: http://dx.doi.org/10.11610/ Connections.12.2.04.
De Kerckhove, Ferry, (2015). The Strategic Outlook for Canada. Vimy Paper Vol.22 – 2015. Conference of Defence Associations Institute, Ottawa, Ontario, Canada. ISBN 978-1-928082-01-9
DoD and CAF. (2013). Defence Renewal Charter. Department of National Defence and the Canadian Armed Forces. Retrived from: http://www.forces.gc.ca/assets/FORCES_Internet/docs/en/about/defence-renewal-charter.pdf
ISAC fond. (2006). Vodic kroz parterstvo za mir. ISAC fond, Beograd.
Keene, S. (2015). The Effective Use of Reserve Personnel in the U.S. Military: Lessons from the United Kingdom Reserve Model. *Report,* Strategic Studies Institute and U.S. Army War College Press. Retrieved from: www.strategicstudiesinstitute.army.mil/ pubs/display.cfm?pubID=1245
Leslie, A., et all. (2011). Report on Transfromation 2011. Canadian Forces, Department of National Defence. Retrieved from: http://mldc.whs.mil/public/docs/library/allportfolios/Canadian_Report-Military_Transformation-2011.pdf
Miles, R., Snow, C., Fjeldstad, O., Miles, G., Lettl, C. (2010). Designing Organizations to Meet 21st-Century Opportunities and Challenges. *Organizational Dynamic*, 39(2), 93-103. doi: 10.1016/j.orgdyn.2010.01.009
Nikolic, N. (2015, October). Serbian Security Perceptions: Motivations to Serve. *Information & Security: An International Journal*, 33(2), 122-137. (http://dx.doi.org/10.11610/isij.3306).
Peever, D.,et al, (2014). First Principle Review: Creating One Defence.
Petrovic, Z. (2007). Ratna vojska Srbije u uslovima potpune profesionalizacije. *Vojno Delo,* 59(4), 108-130. ISSN 0042-8426.
Sedivy, J. (2013). NATO and Reserve Forces – a Czech View. *The Officer*, 2013, Retrieved from: www.mzv.cz/nato.brussels/en/news_articles_speeches/ index_2.html
Soldatovic, I. PR Impact on Public. (2013). Confidence in Military and Police in Serbia. *Management Journal for Theory and Practice Management*, 67, 77-83. doi: 10.7595/management.fon.2013.0007
Szvircsev, T. (2014, 3-4 December). Europe's Armed Forces in Transition: From Conscription to all-volunteer forces 1975-2014. *International Workshop "10 Years after Suspending Conscription: Transition and Transformation*".
Taylor, J., Clerkin, R., Ngaruiya, K., and Knox Velez, A.L. (2015). An Exploratory Study of Public Service Motivation and the Institutional-Occupational Model of the Military. *Armed Forces & Society,* 41(1), 142-62. Retrieved from: //dx.doi.org.10.1177/0095327X13489119
Wiggins, B., Evans, S., Luchman, J., Gibson J. (2014). Motivators and Barriers to Recruiting Prior Service Members in the IRR. *Military Psychology*, 26(1), 23-32. //dx.doi.org/10.1037/mil0000026
Winkler T., Gyarmaty I., Remilard M., Vesel S. (2002). Post-Cold War Defence Reform: Lessons Learned in Europe and the United States. Potomac Books Inc., Washington, D.C.

STRATEGIC PERFORMANCE MANAGEMENT SYSTEM IN PUBLIC SECTOR: THE ROLE OF KNOWLEDGE MANAGEMENT

Zorica Mitrović*1, Dragan Bjelica[1] Danijela Toljaga Nikolić[1]
[1]Faculty of organizational sciences
*Corresponding author, e-mail: zorica.mitrovic@fon.bg.ac.rs

Abstract: *The aim of this paper is to argue the introduction of knowledge management as a building pillar for strategic performance management in Serbian public administration. First, the practice of developed countries already confirmed that strategic performance management system is a key for increasing efficiency and effectiveness of public sector organizations. This paper provides the theoretical background for considering the importance of establishing a strategic performance management system to enable public sector bodies to move forward with the reform process. Second, the knowledge management is confirmed to be a crucial element of organizations capability to achieve high organizational performances. The success of the concept in the private sector led to its introduction in public sector organizations. This paper provides a rationale for considering the knowledge management as an integral part of the strategic performance management system. Finally, the paper recommends the further research in this field and promotion of such idea among both scholars and practitioners.*

Key words: *knowledge management, performance management, strategic management, management system, public sector*

1. INTRODUCTION

Strategic performance management system is a key for increasing efficiency and effectiveness of public sector organizations (Mitrović, Todorović, & Bjelica, 2013). Even though there is no widely accepted definition, the most authors define it as an umbrella concept that provides integrated application of different methodologies including Strategic Management, Performance Management, Knowledge Management, Total Quality Management, Six Sigma, etc.

The first driver for the introduction of performance-based management was the wave of reforms in a public administration known as New Public Management (NPM). The performance-based management was introduced in the 1990s as an NPM initiative. It represented result-based management practice and one of the basic doctrines of NPM. As a concept, the NPM represented a wide range of reform programs and the step forward from narrow debates that were normal in the area of public policy administration and management most of the 20th century (Hood, 1991). It emerged in the 1980s in Great Britain during the mandate of Prime Minister Margaret Thatcher. Even though the idea already existed, Margaret Thatcher was the first to successfully made culture, size and cost of the British public service as a political issue. After that, the changes were made in the policy of public sector in the field of organization and methods, public services and employment, expenditure planning and financial management, audit and evaluation, and supply (Brazelay, 2001) (Mitrović, Todorović, & Bjelica, 2013). Further, the issue of public sector management was high on the agenda of the Conservative government too. Agenda included initiatives such as the *"Next Step Initiative", "Citizen Charter Initiative"*, *„Competing for Quality"*, *„Resource Accounting and Budgeting"* and *„Private Finance Initiative"* (Brazelay, 2001). Similar initiatives emerged in the United States. One of the most significance were *"National Performance Review"* and its transformation in the Law *"Government Performance and Results Act"* (Brazelay, 2001). During this period, the issue of public sector management has become a very popular area of policy in many other countries, such as New Zealand, Australia, Sweden, Canada, etc. As a result of these changes in developed countries all around the world, the Organization for Economic Cooperation and Development (OECD) established Public Management Committee and Secretariat (PUMA) to help its members to address the challenges. Following the path, the developing countries started with an application of the wide-ranging public administration reforms. The NPM provided standardized, Western approach to public administration reform with the principles such as citizen-centric governments, decentralization, the split between policy making and policy implementation, etc.

The second driver for the introduction of performance-based management as a part of the public administration reform process in developing countries were Structural adjustment reforms mainly initiated by International Financial Institutions. Structural adjustment programs were targeting cost reduction of the government. Finally, the third driver was the transition from central planning to market economy what initiated the change in orientation of the system of public administration.

All three drivers influenced the public administration reform in Serbia. The following chapter provides the background for public administration reform and the roots of establishing strategic performance system in Serbian public sector. Also, it provides the rationale for considering the knowledge management as a next step for improving the performance of Serbian public sector.

2. PUBLIC ADMINISTRATION REFORM AND THE STRATEGIC PERFORMANCE MANAGEMENT SYSTEM IN SERBIA

The reform process of Serbian public administration started in 2004. The main objectives that Government of Serbia (GOS) planned to achieve through the reform was the creation of democratic state and citizen-centric public administration. The reform process started with the adoption of two main documents The Public Administration Reform Strategy (PAR Strategy) and an Action Plan (AP) for implementation of the PAR Strategy. With these documents, GOS set a goal to build efficient, responsive, transparent and accountable public administration. On the other hand, PAR was developed as a very comprehensive framework, that included regulatory reform, public finance reform, but also targeted reforms in specific areas. With the aim to harmonize Serbian public administration with the principles of the European public administration space the five principles of decentralization, de-politicization, professionalization, rationalization and modernization were adopted.

Since 2004, a wide range of actions has been undertaken in different public sector institutions, including ministries, public agencies, special organizations, local self-governments and public companies. The aim of the whole range of actions was to provide efficient management and efficient state functioning at all management levels. For example, in the field of planning, budgeting, monitoring and reporting, the process started in 2005 when the Government of Serbia launched the project *Joint Project - Towards the More Effective Implementation of Reforms: Improving Planning, Budgeting, Monitoring, and Reporting.* The aim was to improve the efficiency and the effectiveness of the central public administration.

The implementation of extension projects followed from 2007-2012 under different names and financed by different donors, but with the same objectives. As a result, the policy-making and co-ordination system was improved. The legal framework was revised including a revised Rules of Procedure, Regulation on the General Secretariat of the Government, and Regulation on the Cabinet of the Prime Minister. Further, there were legally established committees of ministers to discuss items before their reaching the government session, all supported by the General Secretariat of the Government.

The new Rules of Procedure enabled the introduction of the government's collective responsibility, requiring that in all public communications members of the government should support its decisions regardless of their views or of how they voted in the government sessions (Obradović, Mihić, & Mitrović, 2011). Also, it provided with basic requirements for policy preparation in ministries, including appropriate procedures for inter-ministerial consultations, public debate, certification of harmonization with the *acquis*, assessment of alternative approaches, assessment of financial consequences, and a full regulatory impact assessment (RIA) (Obradović, Mihić, & Mitrović, 2011). A new Budget System Law introduced a more policy-driven budget process and the middle term planning methodology as a key element of policy and budget planning. From 2013-2015, major efforts were put in the implementation of budget programming at central government level, but also on local self-government level.

To summarize from 2005-2015 in the field of planning, budgeting, monitoring and reporting, reform process included building and developing capacities firstly for annual planning, upgrading to middle-term planning and program budgeting. This included building capacities for result based management by the introduction of elements of strategic performance management such as setting strategic direction within budget plans and the introduction of performance measures. Also, the reform process included building the accountability system and monitoring and reporting system. But to close the management loop the reform process need to build capacities to use performance information and knowledge to drive the improvement. This paper advocates that knowledge management is the missing piece of the strategic performance management in public sector organizations.

The rationale is that all high-performance organizations are in need for effective strategic performance management systems since it is the only way that enables them to remain high-performance organizations. The building pillars of such system are strategic planning, performance measurement, accountability system and knowledge management system (Mitrovic, Todorovic, & Bjelica, 2015). Further, the knowledge management system has a significant impact on improving the performance of the organization (Ahn & Chang, 2004; Al Mashari, Zairi, & AlAthari 2002; Choi Poon, & Davis, 2008; Fugate, Stank, & Mentzer, 2009; Syed-Ikhsan & Rowland, 2004). Since the Serbian public sector is under pressure to improve performance

the knowledge management system could be the solution to the problem. Establishing a knowledge management system requires the definition of the process of knowledge management, the necessary data, tools, and organization. This knowledge management system should integrate monitoring and reporting system to include data collection and the process of analyzing, reviewing and reporting, but also to use the information to create the knowledge and use it to improve performance. In the context of Serbia, the big challenge is to understand what the knowledge management is and experiences of developed countries to define the possible role in the strategic performance management system in Serbian public sector. The following chapters provide the theoretical considerations of the concept of knowledge management and the application of knowledge management in public sector mostly in developed countries.

3. THE CONCEPT OF KNOWLEDGE MANAGEMENT

The contemporary theory of management promotes Knowledge management (KM) as prominent and an important management topic in organizations all around the world. Companies that recognize the importance of knowledge management shape their business strategy and appoint chief knowledge officers for knowledge creation, diffusion, and utilization and establish knowledge management systems (Noh, Kim, & Jang, 2014).

In the context of the knowledge-based economy, the concept of knowledge management is a building block of the new integrated value chain where knowledge is both product and resource that enables organizations to achieve success in the struggle with complexity in a highly competitive environment. Further, the competitive advantage is not guaranteed with the process of generating knowledge, but rather with knowledge value as a factor that represents the potential of an organization to create additional value (Tisen, Andriesen, & Depre, 2006).

The importance of knowledge is recognized by the various scholars who perceive the need for managing the knowledge as an ultimatum of contemporary business (Riege & Lindsay, 2006). For example, the theory of resource-based view highlights the knowledge as the most important strategic resource, and a means to achieve competitive advantage (Pee & Kankanhalli, 2015). Peter Drucker states that knowledge is a basic resource in the post-capitalist society, where capital, natural resources and labor take a second place (Drucker, 1993). However, the knowledge as a resource gets its practical value only with the implementation of knowledge management system, which transforms knowledge into an added value and as a result enables improving organizational performance (Drucker, 1993) (Nonaka & Takeuchi, 1995).

The idea of knowledge as the value of the organization is articulated in the early 1980s when organizations started to use expert systems. However, the first discussions about the role of knowledge in shaping the organizations future as well as the term «knowledge worker» is defined back in the 1950s in Peter Drucker's work *"The Landmarks of Tomorrow"* (Drucker, 1954). The very own term «knowledge managment» originated in the 1980s, characterizing the way that value is created for customers with the unique offer of products and services (Porter, 1985). Besides authors like Drucker, Porter, Nonaka and Takeuchi-a, the outstanding contribution to the development of the doctrine of knowledge management had Peter Senge by developing the theory of "learning organization" (Senge, 1990).

However, the momentum of development of the knowledge management theory was in the early 1990s. Firstly in the corporate world, and the decade later the interest was gradually transferred to public sector organizations. The complexity of the environment of public sector organizations and the role they have indicated the need for the implementation of interdisciplinary business model based on knowledge, which will enable them to stand at the forefront of changes that shape society, not chasing for the changes that the corporate world imposes.

Knowledge management is a complex concept. There were various attempts of researchers to define the knowledge management and still there are many different definitions, and each of them is widely accepted. Fore example, Nicolas (2004) describes KM as a systematic process of creating, acquiring, disseminating, leveraging and using knowledge to achieve competitive advantage. Similarly, the knowledge could be defined in various ways. One of the widely accepted definitions is by Davenport and Prusak (2000): *"Knowledge is a combination of experiences, values, contextual information and expert insights that enable organizations to evaluate and absorb new experiences and information."* Further, there are two types of knowledge, explicit and tacit. Tacit knowledge is difficult to articulate or communicate, and typically resides in a human mind, it is deeply rooted in action, commitment, and involvement in a particular context (Nonaka, 1994). Explicit knowledge refers to knowledge that has been captured in some tangible forms, and the knowledge that is transmittable in formal, systematic language (Nonaka, 1994). The knowledge is created via conversion between tacit and explicit knowledge, through processes of combination, internalization, socialization, and externalization.

To utilize created knowledge, organizations need to build knowledge capabilities that will enable them to achieve superior performances and competitive advantage. The knowledge capabilities are based on the level of development of knowledge infrastructure that some authors refer as infrastructure capabilities (Wu and Hu, 2012) or knowledge enablers (Noh, Kim, and Jang, 2014). Regardless the term, this infrastructure refers to technology, structure, and culture (Gold, Malhotra, and Segars, 2001) and people. The other element of knowledge capabilities of organizations is knowledge process. The four primary organizational knowledge management processes: knowledge creation, knowledge storage and retrieval, knowledge distribution, and knowledge application (Alavi & Leidner, 2001).

Various researchers investigated the relationship between knowledge infrastructure, knowledge management process and performances of organizations (Adeoti, 2002) (Noh, Kim, and Jang, 2014) (Pee and Kankanhalli, 2015). The authors agreed that knowledge management capabilities are determinant of organizations performance (Murray, 2002) (Marques and Simon, 2006) (Choi, Poon, and Davis, 2008) (Akdere, 2009) (Ho, 2009) (Gholami, Asli, NazariShirkouhi, and Noruzy, 2013) (Todorovic, Petrovic, Mihic et. al, 2015). On the other hand, the organizations need a systematic approach to knowledge management to enable full use of created knowledge. The knowledge management system has to be integrated as a building pillar of the management system.

Successful application of knowledge management concept in private sector organizations led to increasing interest in public sector organizations. The interests came with pursuing greater efficiency and effectiveness in public sector institutions at all levels including the central level (ministries, public agencies, and special organizations), local self-government institutions and public companies.

4. KNOWLEDGE MANAGEMENT IN PUBLIC SECTOR

Knowledge management in public sector organizations is not a new idea. However, many factors have influenced to become an important topic of discussion and the topic of numerous discussions. Globalization, the impacts of the information society, demographic changes and a constant high level of unemployment have created unprecedented pressure to improve the competitiveness of the public sector organizations (Sotirakou & Zeppou, 2004). The pressure is even higher with the role that public sector organizations have in the creation of the necessary conditions and infrastructure for achieving competitiveness and efficiency of the private sector at national, regional and local level (Hartley & Skelcher, 2008). With the increasing importance of knowledge as a source of competitive advantage and the critical resource used to create value, public sector organizations are beginning to pay more attention to the implementation of strategies, policies, and programs for the knowledge management (King & Zeithaml, 2003).

The wave of reforms that started in the 1980s made significant changes in the way public sector organizations were functioning before. The pressure was even higher when the new stream of analysis what public administration do and how does it, started back in the 1990s. In the context of modernization running the government as an enterprise become imperative (Sotirakou & Zeppou, 2004). And public sector organizations adopted the new principles of management such as efficiency, effectiveness, economy, transparency, and accountability (Flynn, 2005). At the same time, the public administration institutions recognized the benefits of knowledge management practice in improving efficiency and effectiveness (Yao, Kam, & Chan, 2007) (Riege & Lindsay, 2006) (McAdams & Reid, 2001). For example, connecting the silos of information across different level of the state administration ensured the improvement of the efficiency and effectiveness of the process of public services provision (Riege & Lindsay, 2006). Similarly, improving accountability through the faster decision-making process and solving the problems enabled access to integrated, transparent information beyond organizational boundaries (Riege & Lindsay, 2006).

Further, the reform initiated the promotion of service design and the citizen-customer orientation (Flynn, 2005). That created the need for organizations to improve the quality of service (McAdams & Reid, 2001), what was done through constantly learning and innovating to satisfy the requirements of end-users, but also the other levels of government, various stakeholders and complex inter-organizational structures (Rashman, Withers, & Hartley, 2009). Furthermore, the NPM has promoted collaboration, arguing that it is needed in the service area as well as in the area of policy-making (Flynn, 2005). With public sector organizations increasingly use information technology for collaboration, there was an increasing need to develop the capacity of organizations to support these processes (Pee & Kankanhalli, 2015). One of the creations for the improvement of collaboration were so-called "public sector knowledge networks".

These networks emerged with the implementation of advanced networking technologies and the development of e-government, representing socio-technological systems in which the human, organizational and institutional factors exist in interdependent connection with processes, software and other information

technology (Dawes, Cresswell, & Prado, 2009). Depending on the function that should be carried out, the focus of the network is to provide a solution to the problem or to provide the support to the certain processes by creating system capacities to share knowledge and information within the organization. Examples of such networks are the national information system for the distribution of geodetic information and expertise, or the network that supports the distribution of data on public health, environmental data, etc.

The concept of knowledge management has been and still is instrumental in modernizing the public sector. Over the past two decades, it was present in the different parts of the public sector and influenced the changes that have taken place over this period. In these circumstances, the strategic knowledge management becomes the key to the success of the transformation process of public sector organizations (Sotirakou & Zeppou, 2004) (Edge, 2005). At the same time, the knowledge management was defined as an eclectic body of knowledge that includes knowledge management in a systematic manner, including all kinds of knowledge within all levels and types of organizations (McAdams & Reid, 2001).

Not only that the knowledge is necessary for transformation, but it is also central to policy making and public service delivery (Blackman, Kennedy, Burford, & Ferguson, 2013) (Kim & Lee, 2006). Both politicians and civil servants use knowledge to shape the environment in an attempt to create additional value (Bridgman & Davis, 2004). In the case of public sector organizations, additional value is not profit, but the public value that is in many cases perceived as the way the citizens' needs are satisfied (Moore, 1995). Regarding, the public administration has an important role in public policy that will affect the successful creation of value for the whole community (Riege & Lindsay, 2006). This responsibility for the delivery of public policies that bring public good increases the importance and role of effective knowledge management in the public administration (Wiig, 2002).

On the other hand, it seems that good public policy occurs when the knowledge owned by the society is effectively transform into public administration knowledge and when the different policy options are in return tested by appropriate transfer of knowledge between the government and the stakeholders, through the publication of policy monitoring and review (Bridgman & Davis, 2004). Knowledge management in the public sector includes the different roles of stakeholders in policy development, through the process of creating knowledge, design skills, knowledge dissemination and application of knowledge (Riege & Lindsay, 2006).

Knowledge management enables organizations to deliver the right information to the right person at the right time, helping organizations to make right decisions. In this process creation and transfer of knowledge becomes a critical factor in competitiveness and organizational success (Chawla & Joshi, 2010). The way the knowledge is managed determines the decisions that will be made and actions to be taken. Therefore, it is clear that improving the quality of the knowledge management process, determines the quality of the decision-making process and resulting activities of the organization (Chawla & Joshi, 2010).

Wiig (2002) proposes following areas of knowledge management application: improving the decision-making process within the public sector organizations, the help to the public to effectively participate in decision-making in the public sector, the construction of a competitive society intellectual capital and competitive development of the workforce, whose competitiveness is based on knowledge.

Further, Pee & Kankanhalli (2015) identifies two trends: the human capital crisis due to downsizing, resignation, or retirement calls for more effective capturing of knowledge to minimize knowledge loss; and increasingly use of information technology in public sector organizations to collaborate with one another. For instance, McAdams & Reid (2001) noticed that knowledge management is especially important in the public sector if we take into account that civil servants have long been identified as key knowledge depository. And the organization itself as a knowledge-based organization (Khan, 2009). The problem is caused by the perception of knowledge as the private property of employees in the public sector (Kim & Lee, 2004). Therefore, one of the critical issues and big challenges, since 2000 was how to retain critical skills in organizations and how to make the transfer of knowledge - especially tacit knowledge – to the younger generation to ensure institutional memory (Aija, 2001).

This increasing interest in the use of knowledge management in the public sector was related improved efficiency, cost reduction and improved quality (McAdams and Reid, 2000). On the other hand, (Wiig, 2002) studied the role of knowledge management in building society's intellectual capital to improve the effectiveness of public decision-making and situation handling. More recently, (Pee and Kankanhalli, 2015) literature review showed that knowledge management found to be instrumental in policy development, law enforcement, crisis and disaster management, health and human services, and electronic government. There are, however, some challenges associated with successful implementation of knowledge management practice in the public sector. Lastly, public administration tasks and services are being perceived as knowledge-intensive in nature and excelling in KM can potentially enhance public organizations'

effectiveness. Further, examples of knowledge management practices include the application in different sectors such as education (Edge, 2005), police (Seba and Rowley, 2010), health sector (Van Beveren, 2003), etc. Efforts also included the research on specific aspects of knowledge management framework such as collaboration and networking (Dawes, Cresswell, and Prado, 2009), organizational learning and knowledge sharing (Rashman, Withers, and Hartley, 2009) (Yao, Kam, and Chan, 2007) (Amayah, 2013), and relation between KM and organizational performance (Pee and Kankanhalli, 2015).

The importance of the topic gains the attention of the OECD, which in 2002 launched an international survey regarding the practice of knowledge management in the ministries, agencies, central governments of OECD countries. The key findings of the survey were following:

- KM ranks high on the management agenda of a good majority of central government organizations across OECD member countries.
- Central government organizations are making concrete efforts to improve their KM practices increasingly using.
- Cultural change is taking place.
- Increased openness, transparency policies, as well as investments in ICTs, have resulted in a perceived increased efficiency, transparency and outward focus.
- The improved competitiveness of the public employer, a more horizontal and less silo type of hierarchical structure, a better make up for the loss of knowledge and the promotion of life-long learning.
- The improvement of KM practices requires time and long-term efforts to change behavior, and to impact on the culture of the organization. Good KM practices are best enhanced by long-term behavior reflecting trust among civil servants, team spirit, and selflessness and best supported by a relatively stable organizational and cultural environment.
- Finally, improved KM practices come with an added cost regarding information overload and wasted time in consultation for a majority of organizations and a dilution of responsibilities for a large minority of organizations.

European Union also initiated the actions regarding knowledge management practice in public sector organizations, recognizing that organizational innovation and the creation of knowledge-empowered e-government will lead to better and more efficient services and empower civil servants in his / her task, supporting the complexity of decision-making and collaboration (Butler, Feller, Pope, Emerson, & Murphy, 2008).

This literature review showed the various roles that knowledge management has in improving the performances of public administration at all levels.

6. CONCLUSION

The paper argued that knowledge management should be integrated as a building pillar for strategic performance management in Serbian public administration. The argumentation is based on experiences of developed countries that strongly suggested that strategic performance management system is a key for increasing efficiency and effectiveness of public sector organizations. This paper provides the theoretical background for considering the importance of establishing a strategic performance management system to enable public sector bodies in Serbia to move forward with the reform process. The rationale is based on three drivers. The first driver for the introduction of performance-based management was the wave of reforms in a public administration known as New Public Management (NPM). The second driver for the introduction of performance-based management as a part of the public administration reform process in developing countries were Structural adjustment reforms mainly initiated by International Financial Institutions. Finally, the third driver was the transition from central planning to market economy what initiated the change in orientation of the system of public administration. As a result from 2005-2015 in the field of planning, budgeting, monitoring and reporting, reform process included building and developing capacities firstly for annual planning, upgrading to middle-term planning and program budgeting. This included building capacities for result based management by the introduction of elements of strategic performance management such as setting strategic direction within budget plans and the introduction of performance measures. Also, the reform process included building the accountability system and monitoring and reporting system. But to close the management loop the reform process need to build capacities to use performance information and knowledge to drive the improvement. To further support the discussion the knowledge management concept, as well as its application in public sector organizations is discussed. The argumentation presented in this paper strongly recommends the further research in this field and asks for full cooperation politicians and scholars.

ACKNOWLEDGEMENTS

This paper is a result of Strategic Project founded by Ministry of Education and Science of republic Serbia: Exploring modern trends of strategic management of the application of specialized management disciplines in the function of the competitiveness of Serbian economy, No 179081.

REFERENCES

Adeoti, J. O. (2002). Building technological capability in the less developed countries: the role of a national system of innovation. *Science and Public Policy, 29* (2), 95-104.

Aijala, K. (2001). *Public sector - an employer of choice? Report on the competitive public employer project.* OECD.

Akdere, M. (2009). The Role of Knowledge Management in Quality Management Practices: Achieving Performance Excellence in Organizations . *Advances in Developing Human Resources, 11* (3), 349-361 .

Alavi, M., & Leidner, D. (2001). Knowledge management and knowledge management systems: Conceptual foun- dations and research issues. *MIS Quarterly, 25* (1), 107-136.

Amayah, A. (2013). Determinants of knowledge sharing in a public sector organisations. *Journal of knowledge management*, 454-471.

Blackman, D., Kennedy, M., Burford, S., & ferguson, S. (2013). Introduction to special symposium on knowledge managment and public administration: Good bedfellows or potential sparring partners. *International Journal of Public administration , 36* (3), 151-154.

Bloger, J. (2000). *Capacity Development: Why, What, and How.* Quebec: CIDA Policy Branch.

Bridgman, P., & Davis, G. (2004). *The Australian Policy Handbook.* Sydney: Allen & Unwin.

Butler, T., Feller, J., Pope, A., Emerson, B., & Murphy, C. (2008). Designing a core IT artefact for knowledge management systems using participatory action research in a goverment and a non-goverment organisation. *journal of Strategic Information Systems, 17* (4), 249-267.

Chawla, D., & Joshi, H. (2010). Knowledge management initiatives in Indian public and private sector organisations. *Journal of knowledge management , 14* (6), 811-827.

Choi, B., Poon, S. K., & Davis, J. G. (2008). ffects of knowledge management strategy on organizational performance: A complementary theory-based approach. *The International Journal of Management Science, 36* (1), 234-251 .

Davenport, T., & Prusak, L. (2000). *Working Knowledge: How Organizations Manage What they Know.* Boston: Harvard Business School Press.

Dawes, S., Cresswell, A., & Prado, T. (2009). From "Need to Know" to "Need to Share": Tangled Problems, Information Boundaries, and the Building of Public sector Knowledge Networks. *Public Administration Review* , 392-402.

Dean, G., Filsted, C., & Gottschalk, P. (2006). Knowledge sharing in criminal investigation: an empirical study of Norwegian Police as value shop. *Criminal Justice Studies , 19* (4), 423-437.

Drucker, P. (1954). *Practice of Management.* London: William Heinemann Ltd.

Drucker, P. (1993). *Post Capitalist Society.* Oxford: Butterworth-Heinermann.

Drucker, P. (1995). *The Post-Capitalist Society.* Oxford: Butterworth-Heinemann.

Edge, K. (2005). Powerful public sector knowledge management: a school district example. *Journal of knowledge management, 9* (6), 42-52.

Flynn, N. (2005). *Public Sector Management.* London: SAGE Publications.

Gholami, M. H., Asli, M. N., NazariShirkouhi, S., & Noruzy, A. (2013). Investigating the Influence of Knowledge Management Practices on Organizational Performance: An Empirical Study. *Acta Polytechnica Hungarica*, 205-216.

Gold, A., Malhotra, A., & Segars, A. (2001). Knowledge management: An organizational capabilities perspec- tive . *Journal of Management Information Systems, 18* (1), 185-214.

Hartley, J., & Skelcher, C. (2008). The agenda for public service improvement. In J. Hartley, C. Skelcher, C. Donaldson, & M. Wallance, *Managing to Improve Public Service*, 3-23. Cambridge: Cambridge University Press.

Ho, C.- T. (2009). The relationship between knowledge management enablers and performance. *Industrial Management and Data Systems, 109* (1), 98–117 .

Hood, C. (1991). A Public Management for all Seasons. *Public Administration, 69* (1), 3-19.

Khan, I. (2009). Knowledge groups: A model for creating synergy across the public sector. *Public Organization Review , 10* (2), 139-152.

King, A., & Zeithaml, C. P. (2003). Measuring organisational knowledge: a conceptual and methodological framework. *Startegic Mnagament Journal, 44* (1), 409-424.

Ling, T. (2002). Delivering joined-up government in the UK: dimensions, issues and problems. *Public Administration, 80* (4), 615-642.

Luen, T., & Al-Hawamedeh, S. (2001). Knowledge management in the public sector: principles and practice in police work. *Journal of Information Science*, 311-318.
Marques, D. P., & Simon, F. J. (2006). The effect of knowledge management prac- tices on firm performance . *Journal of Knowledge Management, 10* (3), 143-156 .
McAdams, R., & Reid, R. (2001). A comparasion of public and private sector perceptions and use of knowledge management. *journal of European Industrial Training , 24* (6), 317-329.
Mitrović, Z., Todorović, M., & Bjelica, D. (2013). Strategic performance management system of public sector organizations in Serbia: The role of an accountability system. *Serbian Project Management Journal* , 63-71.
Mitrović, Z., Todorović, M., & Bjelica, D. (2015). Theoretical framework of Integrated Strategic Performance Management System. *Serbian Project Management Journal*, 63-71.
Moore, M. (1995). *Creating Public Value: Strategic Management in Goverment.* Cambridge: MA: Harvard University Press.
Murray, P. (2002). Knowledge management as a sustained competitive advantage. *Ivey Business Journal , 66* (4), 71–76 .
Nicolas, R. (2004). Knowledge management impacts on decision making process. *Journal of Knowledge Management , 8* (1), 20-31.
Noh, M., Kim, H., & Jang, H. (2014). learning performance and business performance of knowledge management organisations: The moderating effect of technological capability. *Information development* , 1-18.
Nonaka, I. (1994). A Dynamic Theory of Organizational Knowledge Creation. *A Dynamic Theory of Organizational Knowledge Creation , 5* (1), 14-37.
Nonaka, I., & Takeuchi, T. (1995). *The Knowledge - Creating Company.* Oxford: University Press.
Obradović, V., Mihić, M., & Mitrović, Z. (2011). Experiences and challenges of the central government capacity building: the case of Serbia. *9th International scientific conference – "Serbia facing the challenges of the globalization and sustainable development"*, 165-170. Belgrade: Megatrend University.
OECD. (2000). *Knowledge Management in the Learning Society.* Paris: OECD Publishing.
OECD. (2003). *Conclusions from the results of the survey of knowledge management practices for ministries/departmants/agencies of central goverment in OECD member countries.* GOV/PUMA/HRM: OECD.
OECD. (2006). *he Challenge of Capacity Development: Working Towards Good Practice.* Paris: Organization for Economic Cooperation and Development (OECD).
Otoo, S., Agapitova, N., & Behrens, J. (2009). *The Capacity Development Results Framework.* Washington: World Bank Institute .
Pee, L., & Kankanhalli, A. (2015). Interactions among factors influencing knowledge management in public-organisations: A resource-based view. *Goverment Information Quaterly* , Article in press.
Porter, M. (1985). *The Competitive Advantage: Creating and Sustaining Superior Performance.* New York: Free Press.
Rashman, L., Withers, E., & Hartley, J. (2009). Organisational learning and knowledge in public services organisations: A systematic review of the literature. *International Journal of Management Reviews , 11* (4), 463-494.
Riege, A., & Lindsay, N. (2006). Knowledge management in the public sector: stakeholder partnerships in the public policy development. *Journal of knowledge management , 10* (3), 24-39.
Seba, I., & Rowley, J. (2010). Knowledge management in UK police forces. *Journal of knowledge management , 14* (4), 611-626.
Senge, P. (1990). *The Fifth Discipline: The Art and Practice of learning organisation.* New York: Daubleday Dell Publishing Group.
Sotirakou, T., & Zeppou, M. (2004). The "MATE" model: a strategic knowledge management technique on the chessboard of public-sector modernisation. *Management Decision , 42* (1), 69-88.
Tisen, R., Andriesen, D., & Depre, F. L. (2006). *Dividenda znanja.* Novi Sad: Adizes.
Van Beveren, J. (2003). Does health care for knowledge management? *Journal of Knowledge Management , 6* (5), 420-433.
Wiig, K. M. (2002). Knowledge management in public administration. *Journal of Knowledge Management , 6* (3), 224-239.
Wu, I.-L., & Hu, Y.-P. (2012). Examining Knowledge Management Enabled Performance for Hospital Professionals: A Dynamic Capability View and the Mediating Role of Process Capability. *Journal of the Association for Information Systems* , 976-999.
Yao, L., Kam, T., & Chan, S. (2007). Knowledge sharing in Asian public administration sector: the case of Hong Kong. *Journal of Enterprise Information Management , 20* (1), 51-69.

THE SIGNIFICANCE OF THE PARADIGM OF GRADUAL EVOLUTION FOR THE DEVELOPMENT OF THE DEFENCE SYSTEM

Vladimir Ristić*1, Srđan Blagojević [1],
[1]University of Defence in Belgrade
*Corresponding author, e-mail: vladimir.ristic@mod.gov.rs

Abstract: *The development of the defence system, in a certain way, represents the creation of the system's future that is appropriate to the environmental conditions, and the current and future needs. It is a process or procedure of selection and implementation of optimal goals whose achievement is the best way of dealing with a particular situation. If the state and politics do not develop strong defence, then they have a very limited ability to conduct certain policies. The development of the defense system necessarily is characterized by paradigmatic foundation. Although in the Systems Theory many paradigms are known, regarding the specificity of the defense system and its permanent character, the paradigm of gradual evolution is the most important. The paper gives a description of the importance of paradigm of the gradual evolution for the development of the defence system.*

Keywords*: defence system, development, paradigm, evolution*

1. INTRODUCTION

Modern defence system must be dynamic due to the dynamism of external and internal factors that determine it and must have a permanent feature of the system with regard to the sustainability of the reasons for his constitution.

However, to provide accuracy of the defence system of a certain country at any moment and time, it is necessary for the state to plan and implement its ongoing development. Development, as a term, is nothing more than adding certain positive features to the system, and corresponding changes in the existing situation of a certain system.

Developing power of the system is its ability to survive and develop in a modern society. Survival of the defence system is not treated as a mere possibility of its maintenance, but its ability to respond to current challenges and trends and to achieve the intended function.

Contemporary approaches to the development of the defence system are based on the theory of the system, which enables a comprehensive science-based knowledge of military organizations, as well as specific social entities. As a general systems theory represents scientific discipline that studies the different phenomena in the system, ignoring the specific nature of particular system, there is a need to consider the defence system constantly bearing in mind its specificity. Systems theory explores the formal interconnections between different factors over which manifests appear, and the nature of changes of these interconnections under the influence of external factors and the influence of the environment in general. The focus of the study of the systems are mutual influences of their factors.

As the consequences of bad decisions regarding the development of the defence system could have unforeseeable consequences for the state and society, there can not be place for approaches based on trials and errors and hope that the resultant of this process will be positive. Considering all known paradigms which treat organizational change in general, the paradigm of gradual evolution has the greatest significance for the development of military organizational system.

2. SPECIFICS OF THE DEFENCE SYSTEM AS AN ORGANIZATIONAL SYSTEM

The defence system is a complex organizational system. A precondition of its effective and efficient functioning and the development also, is an appropriate management. In theory, there are numerous attempts to define the concept of managing organizational system in general. This is done in different ways, depending on the point of observation of the problem which needs to be analyzed and depending on the characteristics that want to be highlighted.

From our point, definition offered by Stoner (2000) looks quite acceptable. According to which the management of organizational system is defined as: "the process of planning, organizing, leading and controlling the efforts of all members of the organization and the use of all organizational resources to achieve the objectives of the organization (P. 66). By using this definition, it is possible to identify the key characteristics of this complex process.

We consider planning, organizing, leading and controlling as essential functions of the process of managing the organizational system. Management of the organizational system is aimed at achieving predetermined goals. Managers, as a key drivers of process of managing of the organizational system, decide on the allocation and use of the organizational resources.

However, when it comes to the defence system management, there are certain differences between the defence system management and management of other organizational systems. Objectives and tasks of the defence system are determined by the competent national authorities (Assembly, President, Government, etc.). Managers in the defence system can participate in nomination of its objectives and tasks, but they are solely responsible for their implementation. The purpose of the existence of the defence system is not to make profit but to meet certain state and social needs.

The competent state authorities provide the necessary resources for the realization of the objectives and tasks of the defence system. The jurisdiction of the defence system is purely in efficient use of resources used to achieve the identified goals and objectives. These facts show us that the direction and course of development of the defence system largely depends on the decisions of state authorities. Although all management functions play an important role in ensuring the appropriate functioning of the defence system, the most important one is the function of planning, because it creates the preconditions for the successful implementation of all other functions.

There are certain boundaries between defence system and other social systems. They have a role to prevent many types of interaction between people in the organization and beyond. They are selectively permeable and human, material and information flows that are essential for the normal functioning of organizational systems, freely pass through them.

Hierarchical structure is important trait of the military organizational system. A hierarchical division is not unique to organizations only, but this is the general and common feature of all complex systems. In addition to the hierarchical arrangement that is characteristic for other forms of social organization, subordination constitutes itself as one of the essential specifics of military organizational system.

The defence system is a system of dynamic balance which is very important from the aspect of military organizational system and environment that is not static. For military organizational system's existence under conditions of dynamic environment, it also must be very dynamic and to be able to establish a balance while walking forward, namely to balance in the progressive movement. Feedback mechanism enables defence system to notice the consequences of its activities and activities of the environment and to use these information for appropriate regulation, coordination and adjustments. This mechanism is important for internal-internal relations but also for internal- external relations.

Mechanisms for adaptation and maintenance are very significant and very often they might be in conflict. The mechanism for adaptation's task is to make internal changes on the basis of changes in the environment, in order to adapt the defence system with the external environment, and thus to ensure a dynamic balance. This adjustments cause internal changes that are aimed for a higher level of organization. The mechanism for maintenance's task is to establish an internal balance between organizational subsystems and elements of the defence system. As adaptation mechanism operates continuously and causes changes in order to maintain dynamic balance, then mechanism for internal maintenance is constantly active, too. Given all the specifics of the defence system reported in the previous paragraphs, it is important to state that the changes are necessary in the defence system, but the defence system itself is slow and cumbersome and that is why the dynamics of change must be systematically designed and planned according to social needs.

3. POSSIBLE EFFECTS OF THE DEVELOPMENT OF THE DEFENCE SYSTEM

The effects of the development of the defence system are multiple and can be graded from highest to lowest proportion, according to the goal achieved. The maximum effect is confirmed by the creation of current and future defence system that are appropriate to environmental conditions, current and future needs, which provide permanent deterrence of actual and potential holders of threats and their intents. In order to provide

that the defence system of a state is up-to-date at any moment and time, it is necessary for the state to plan and implement its ongoing development.

The effects of the development of the defence system are multiple, since they mean the highest level of contribution to the vital social interests and goals. In order to give as many as a possible contribution to achieving the vital social interests and objectives, it is necessary to know the exact content and the objective actuality of security. Above all, it is necessary to know the origins of contemporary threats to security and the ability to build a defence system that allow preventive action.

If we observe that the most positive effect of the development of the defence system is compliance with current and future requirements, then our general provision would be defined as follows: The highest level of development of the defence system is reached when it is achieved:

- compliance of defence system with the external policy objectives;
- compliance of defence system with the constitutional provisions;
- harmonization of defence concepts with the strategy of foreign policy.

Accordingly, we can examine the differences among countries relating to these important questions, from which arise different directions of development of the defence systems. In fact, some countries tend to develop as an independent state with full international independence, without entering into alliances and international organizations. To achieve that they need to develop a defence system based on the development of independent forces that are capable of ensuring the country's self-defence against potential risks and threats to its security.

Spheres and the necessity of harmonization, as well as the performance of this complex process are changing the character of the alliances and international organizations. A number of countries decided to enter into an international organization, on condition of maintaining their full sovereignty and the satisfaction of certain conditions which they set themselves before entering a particular organization. There are a large number of countries entering into certain organizations and alliances, and consequently lose their full and receive some limited sovereignty, which is in practice being imposed by the alliance, an organization to which it belongs. Depending on the status of the state and its development aspirations, desired effects depend too.

The effects of the development of the defence system can be considered through achieved agreement that reflects the strength of the defence system, through the directions of its development focused on building the capabilities needed to support certain political decisions relating to the defence of the country. Also one important effect of the development is defined character of the armed forces.

The effect of the development of the defence system is the prominent role of the armed forces in the conduction of foreign policy. Armed forces can be a prominent factor of peace also. Here is a characteristic of omission of aspirations for superiority over the armed forces of other states and the existence of desire to maintain balance and develop trust. In such cases, the effects are achieved by appointing or omission naming enemies and balanced development of cooperation between the two countries with the aim of preserving peace. Full focus of the state on achieving these effects of harmonizing policy and state defence system, will protect state against excessive consumption of state energy in the state financing costly armed forces. However, total reliance on a common accepted peace, and lack or insufficient developmentin the spirit of modern military, may produce tragic consequences for the state.

The effect of development can promote a defence system as a major factor in the offensive policy, too. Strong armed forces and defence system as a whole, provide to the country ability to conduct offensive foreign policy based on the factor of power. As an argument for this is the fact that countries that have a strong military force and nuclear potential, have not been attacked by other countries in recent history. On territories of such states, there were not any international military missions conducted. The pursuit of nuclear powers to suspend the creation of new nuclear powers is only one of the forms of political action to limit the sovereignty of individual states. Conflict of impacts in this area never stops. The effects of the development of the defence system, therefore, can always be shown through military force, the economy and the de facto international relations.

4. PARADIGMATIC AND THE THEORETICAL FOUNDATION OF DEVELOPMENT

A comprehensive planning process of development of the defence system, in addition to reliance on significant diagnostic research requires the need for the necessary application of prognostic research. Prognostic research are carried out in various stages of the process, with the goal of more efficient planning

for defensive purposes. They are primarily aimed at anticipating possible threatening conditions and methods, and ways of circumvention, the prevention and reduction of the effects of the attack which is a social action to overthrow the state. Termiz (2014) believes that "Research methodology of safety occurrences and safety activities is not possible without fundamental understanding of those phenomena and that there are two major difficulties in determining the role and functions of security activities. The first concerns its connection with the state government and the other is conditioned by the characteristics of social power and force, whose main characteristic is versatility". (P.25)

In order to develop a defence system, and to fully present findings that have been reached on some phenomena, it is necessary to know paradigms, theories, concepts, and practical programs developed by the theory and practice. According to Milosavljevic, Radosavljevic (2014) the first action after the observance of the problem which is the reason and a possible general object of the research, is to gain insight into the existing research fund. "Theories and knowledge contained in scientific fund, as a rule belong to certain scientific directions, and are associated with certain paradigms that are in the paradigmatic system." (P. 414). Perhaps this is the key reason why the historian of the development of science Thomas Kuhn, puts scientific paradigm in the center of his theory of the science development, in his book The structure of scientific revolutions (1970). In his view, normal or mature sciences differ from the others in fact that they have a paradigm. The paradigm is not determined by the theory. It is a framework that determines the way of thinking about a phenomenon. The paradigm does this by defining three kinds of assumptions: ontological (about the nature of the phenomenon being studied), epistemological (knowledge about the nature of this phenomenon) and methodological (methods of acquiring this knowledge). It is a framework in which are theories developed, while in the theory are framework of concepts and programs developed, for the practical exploration of the phenomenon. An important feature of the paradigm is that they are not checked. They are composed of axioms, that are impossible to be verified, but only to accept them or not. Therefore, one could say that the paradigm is a kind of religion or ideology for scientists.

But the paradigms tend to developmental changes. So Lida (2004), looking at possible changes in the paradigm that can be a base for the the development of an organizational system, states: "Even if this is minor change within a major paradigm, because it affects corporate and consumer behavior to significant extent, it causes a great concern to policy makers. (P.42.)."

According to their degree of development, sciences can be found in a paradigmatic or preparadigmatic stage. The sciences that are in paradigmatic stage are mature, because in one time they have only one paradigm, to which all valid theories of that time belong. Unlike them, the sciences of the preparadigmatic stage are characterized by the existence of multiple paradigms, and the existence of multiple mutually exclusive picture of reality that is being investigated.

Research of the organizations and organizational change is in the preparadigmati stage. Masic (2001) has considered that in the area of organizational change, three paradigms can be identified (p. 303), as follows:

- The paradigm of gradual evolution;
- Paradigm of interrupted balance;
- The paradigm of revolutionary changes.

5. THE PARADIGM OF GRADUAL EVOLUTION IN THE DEVELOPMENT OF THE DEFENCE SYSTEM

Due to the above specifics of the defence system, its enormous size, the strict hierarchical structure and subordination, the stiffness of the system, changes directed to achieving the development goals are necessarily slow and gradual. It is impossible to develop abilities of the defence system in a short period of time, because it is a complex process that takes some time, and also is determined by need to maintain balance of the system. The defence system cannot be developed when there is a certain crisis that Boin (2010) considered as unexpected and undesirable situation (p 12). That's why we decided to subject to our review would be only paradigm of gradual evolution, while the other two paradigms will not be discussed.

According to the paradigm of gradual evolution, an environment of the organization is relatively stable, and changes are slow, predictable and occur gradually, step by step. By the Kovac and others opinion (2006), the entire organization development takes place through a process of constant change, which gradually changes its appearance and character. (Page 71) According to the paradigm of gradual evolution, the organization adapts to the demands of the environment. These changes have partial character, and they are being implemented gradually and with low intensity. They are also called first order changes or alpha changes.

This setting may impose a number of questions regarding the development of the security environment changes which we have witnessed in recent years. Perhaps many will disagree with our conclusion that the paradigm of gradual evolution has primary application in the development of the defence system and to express argument of rapid and radical changes in the security environment, starting with the Arab Spring, the war in Ukraine, a new cold war cry in Syria and the refugee crisis. However, if you carefully analyze the important factors that led to these changes, it can be concluded that the number of a occurrences have developed much earlier than the events themselves. This confirms the fact that many events could properly and timely predict using the prognostic research based on the paradigm of gradual evolution and which would allow the identification of the necessary directions of development of the defence system.

Given that according to the paradigm of gradual evolution, the changes of environment are slow and predictable (based on trends from the past), the management is able to design appropriate changes in the organization, with minimal time lag. Through implementation of organizational changes, management successfully and continuously maintain the organization in a dynamic equilibrium with its environment.

The development of the defence system is constant, evolutionary process which is determined by the strategic orientations, stimulated by technological advances and a limited economic and political factors. The aim is to maintain the necessary defence capabilities in the era of cuts in public expenditure and increasing demands for efficiency and effectiveness. The paradigm of gradual evolution presupposes the development. According to her, the gradual change of the defence system always lead to a development, or progress to a higher level of organization. The state of defence system after the change will be in some ways and always better than it was I previous situation. The development includes qualitative changes, and they happen according to this paradigm as accumulation of incremental changes, or changes that may be fixed or variable, but they are always positive and developmental.

It is especially important to plan long-term development of the defence system. Long-term planning of the defence system development is an interdisciplinary process that includes a number of different actions and activities which are interdependent and a lot of adjustments and reconciliation between political and military elite, planners, military commanders and other subjects of the defense system are required in their implementation. In connection with long-term defence planning, Kovač and Stojković (2009) argue that "uncertainty and ambiguity pose a major challenge for planners in the defence system, as well as for policy makers." (P.425).

That is why, the great attention is given to researching global strategic trends for a longer period, by the modern armies of the world. A typical example is the research conducted by the British Ministry of Defence. The results of a recent survey which aimed to provide a strategic context and to identify long-term threats and opportunities by 2045, they have published in the fifth edition of the publication Global strategic trend GST (2014). "Global Strategic Trends (GST) describe a broader strategic context which is aimed at those in the Ministry of Defence (MoD), the Government and beyond, who are involved in long-term development plans, policies and capabilities. Without this strategic context, there is a risk that planners and creators of policy and development capabilities assume the future based on already preconceived thoughts and assumptions."(P.3.). Of course, an important role in this process is communication with the public and the timely and adequate informing, and information operations doctrines in which Britain has a hundred years of experience. Principles and concrete examples of British information operations were described in Richard L. (2015) work, with special turn to the current experiment Rainbow in the dark (41-66).

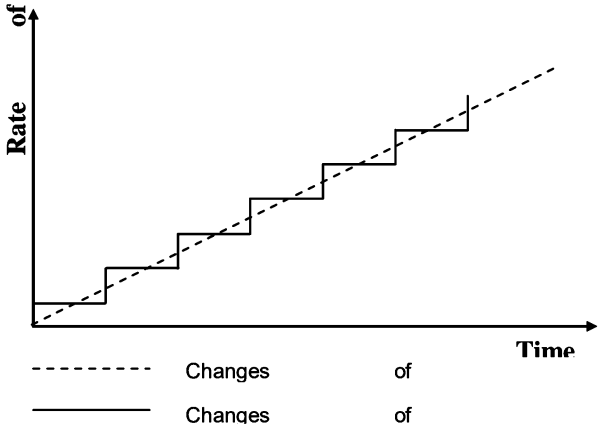


Figure 1: Incremental changes, Kovač and others (2006: 71)

In addition to assuming progress, the paradigm of gradual evolution also includes the assumption on which all subjects experience changes in the same way and they all have the same development path. Such an assumption has led to the creation of the concept of the life cycle of the organization as an instrument for evaluating the performance of management and development of the organization. In the context of the defense system, these development cycles can pose certain planning cycle, from long-term, over the medium and short term.

Therefore, process of changes based on the paradigm of gradual evolution has planned and rational character.

Consideration of policy approaches of own and other countries, analysis of the current security environment, as well as historical trends and events must precede the quality prediction of possible changes in the security environment. Basic entering at this stage are the analysis of national interests and objectives, strategy of national security, the defence strategy for potential opponents and allies, their future role, the role of international organizations and alliances and more.

The first step involves a detailed study of the basic documents relating to national security, defence and foreign affairs to determine the political intentions of other countries, as well as the political implications on the defence system. Thus, the results of this phase are prognosis of political ambitions of neighboring countries and the countries that are the important factors on the world political scene, as well as their political priorities in the field of defence. We are often facing here with the fact that in the available documents of many countries, security and defence objectives and interests are not explicitly formulated, so the key role of prognostic research at this stage should be that they are timely detected.

By this, we can identify national interests that could be impacted by future events, developments and trends in the security environment.

In order to reach a good prognosis, it is necessary to carry out the four essential steps:
- collect the necessary data,
- analysis, sorting and processing of data
- identification of opportunities, risks and threats and
- prognosis of the required number of strategic situations.

In the first step, we will collect the data needed for further work on the prognosis of the future environment. Of particular importance are the data relating to future security, political, economic and social issues, as well as the technological development and the environment. Data sources can be different from the intelligence services to scientific institutions.

The second step requires a good understanding of scientific methodology and analytical knowledge and experience. To obtain reliable results the development of the defence system, operators can use the services of other methodologists and scientists trained in the application of scientific methods in the fields of politics, economy, technology, defence, security, etc.

In the third step, the analysis results are used for the consideration of the impact of future environment on national interests and objectives. At this stage the aim is to identify future opportunities, but also risks and threats to national interests and objectives.

The final step in forecasting future security environment is the development of an adequate number of possible strategic situations which represent future developments in various fields.

It is important to emphasize the importance of the dialogue approach to research and development because it is a matter of effective communication of all relevant stakeholders who are interested in the process of developing the defence system. It includes external stakeholders, respectively the entire public that is sensitive to the issues of development of security and defence. According to the opinion of Flyvbjerg (2012) "Highly specialized media such as scientific journals and monographs are suitable for addressing academic audiences. But they are utterly inadequate when we need to reach out to groups that are relevant in the practical world of politics, administration and planning. Public dialogue that includes communication through daily media is necessary (p.214)". This provides support from the wider public in order to take concrete development steps.

The paradigm of gradual evolution also includes adaptive learning about the possible forms, dynamics and intensity of the security environment changes. However, in addition to the adaptive learning, generative learning is also important for the organization. Adaptive learning or learning in one round (single loop

learning), is based on the knowledge and understanding of changes in the security environment and adaptation to these changes, while generative learning or learning in a double round (double loop learning) is creating and exploring new areas for development of the system. Generative learning does not improve the existing knowledge, but create entirely new competences. Unlike adaptive, generative learning involves another round of referring to the review of the basic premises on which the existing knowledge is based and creating new knowledge, competencies and strategies. However, the strategy itself has no value if it is not implemented properly. Dess, Lumpkin and Isner (2007) nice noted the importance of implementing strategies to achieve the final effect, considering that "the organization must have adequate control and strategic organizational design, but still leadership has a central role in this business." (17)

7. CONCLUSION

By choosing to handle these issues, we were aware of the fact that due to the complexity of the defence system, and the complexity and importance of the process of its development, we cannot expose all aspects of the position and role of the paradigm of gradual evolution in defence research. Therefore, we limited ourselves to only those essential aspects.

Important components of power that are able to directly determine the system of defence can be considered: technical and technological, intelligence and communication, the appropriate number and qualifications. The development of these components will be conditioned by the functioning of various factors whose development, the scope and intensity of the operation cannot always be reliably predicted. Factors that determine the development of the defence system are certainly political, economic, material and energy, social, technological and others. The development of the defence system can be affected by many other factors, but the impact of these specified, primary and fully determines the direction and dynamics of its development.

To perceive these factors in proper perspective and to take advantage of their potential benefits and opportunities created for the defence system, it is necessary to pay special attention to scientific research. As any research is necessary based on a particular paradigm, that requires special emphasis on the types of paradigms which are known in the theory of the systems.

If we consider that the development of abilities and capacities of the defence system is a process that requires some time, because they cannot be built in a short period of time, it is necessary to conclude that the paradigm of gradual evolution is the most important paradigm of development of the defence system. Establishing development without relying on this paradigm, could lead to the situation in practice that some developing countries are caught / surprised by socio-political situation in the country or region. It happens that the defence systems of some countries in certain situations sometimes do not have the ability to meet the requirements that policy puts in front of them, and stay unprepared to respond to a specific attack or other forms of threats that can be applied by compromising entities. This is a manifestation of non-compliance, which can cost a state lack of realization of their vital interests and the objectives, and weakening its overall power, and in worst cases can sometimes lead to state's disappearance.

REFERENCES

Akira L., *Paradigm theory&policy making*, Boston, Massachusetts, 2004.
Boin.A, Hart P. Stern E. Sandelijus B., *Politika upravljanja krizama*, Beograd, 2010.
Dess G., Lumpkin G. i Izner A., *Strategijski menadzment*, Beograd, 2007.
Flyvbjerg Bent, *Making social science matter*, Cambridge University Press, 2012.
Global Strategic Trends-Out-2045, Fifth edition, MoD GB, London, 2014.
Kovač M., Dulanović Ž., Stojković D.,*Određivanje efikasnosti vojnoorganizacionih sistema*, Beograd, 2006.
Kovač M., Stojković D., *Strategijsko planiranje odbrane*, Beograd, 2009.
Kuhn T., *The structure of scientific revolutions (2nd.ed),* University of Chicago, Chicago, 1970.
Lee R., *The Rainbow in the dark: Assessing a century of british military information operation*, Defence strategic comunication, NATO strategic comunication centre of excellence, 41-66. 2015.
Mašić,B., *Strategijski menadžment*, Univerzitet „Braća Karić", Beograd, 2001.
Milosavljević S., Radosavljević I., *Osnovi metodologije političkih nauka*, Službeni glasnik, Beograd, 2013.
Stoner, J., F., Freeman, E., R., Gilbert, D., R.: *Menadžment*, Želnid, Beograd, 2000
Termiz Dž, *Specifičnosti metodologije istraživanja u bezbednosnoj delatnosti*, Sarajevo, 2014.

ANALYSIS OF POSTAL MARKET AS A PRECONDITION DEFINING THE MODEL ACCESS TO POSTAL NETWORK IN REPUBLIC OF SERBIA[1]

Marija Unterberger*[1], Dragana Šarac[1], Spasenija Ožegović[2]
[1] High traffic school „Pinki“ Novi Sad and University of Novi Sad, Faculty of technical sciences, Novi Sad
[2] PE Post of Serbia
*Corresponding author, e-mail: marijaunterberger@gmail.com

Abstract: *The Strategy for accessing the public postal operator (PPO) network is one of the planned Strategies for achieving the objectives of the development of postal services in the Republic of Serbia for the period from 2013 to 2016. The implementation of the Strategy is done through several activities. Some of these activities have already been implemented since the end of 2014. National regulatory authority (NRA) has adopted an „Ordinance on the methods and conditions of access to the postal network of the public postal operator“, and in March 2016 the Post of Serbia has adopted the "Ordinance on special conditions for access to the postal network". Certain planned activities are yet to be realized. Full liberalization of the postal services has not been achieved. There is still a reserved area on the PE Post of Serbia market that hinders the further course of liberalization itself. The final result is to define a model approach with strictly defined conditions of access (access points, the price of access, quantity of items with which to access the postal network). One of the steps in the implementation of these activities is the analysis of the postal services market, which will provide a review of the current state of market liberalization and basic directions for further research in defining the model approach*

Keywords*:* universal service obligation*, postal market, access, the postal network, the public postal operator*

1. INTRODUCTION

The Universal Service Obligation (USO) is one of the main achievements of civilization, which is why each country shall take appropriate steps that should ensure its general availability. In the last twenty years many factors have caused the postal sector in Europe and beyond to review its role on the communication market. The impact of competition, privatization, liberalization, the demand of users for a better and more reliable services, and new technologies have had a major impact on the postal sector and particularlyon designated postal operators. Each state has assigned the obligation to provide universal postal services to designated postal operators, giving them the right and obligation, and on the other hand the ability to secure further existence.

The postal services market in the European Union is still in the process of gradual liberalization. The Directives of European Parliament and Council on the liberalization of the postal market limit the postal monopoly and harmonize the obligations of its members towards the common universal service. The adoption of Directive 2008 (Directive 2008/6/EC) the European Commission has stipulated the need to create a legal framework in the Member States to the full opening of the postal market. On the other hand, the basic objective is the sustainability of the universal service so that all citizens have the possibility of using these services, and the possible appointment of one or more providers USO.

One of the recommendations of Directive 2008, in order to achieve sustainability of the USO, was that *“Member states of the European Union have to adopt measures to ensure access to postal network under transparent, proportionate and non-discriminatory terms, whenever this is necessary in order to protect the interests of users and/or promote effective competition“,* in order to protect the interests of users and ensure continuous, quality and sustainable provision of a universal postal service “ (Directive 2008/6/EC, article 11a).

Access to the postal network implies that the access user shall receive postal items from postal services users, then give them in at an agreed point of access to the postal network for further routing, transport and delivery to the addresses of the recipients, or to act in the same way with their own items, or to use postal network in which the access user delivers mail to the addressee.

The analysis of past experiences in a number of countries that have already defined access to the postal network has showed that the model access differ and are specific for each country, so there is no

[1]*The work is the result of research on the Project TR36040 funded by the Ministry of Education, Science and Technological Development*

transparent methodology for defining the value of certain criteria that define the very model access. Each country defines its own model of access depending on the characteristics of the postal network of the public postal operator as well as of the many characteristics of the postal services market. There is no typical model of approach which could be applied to a particular country or group of countries. For these reasons, each country, based on their characteristics (demographic, social, political, etc.), primarily on the basis of an analysis of the market, creates such a model approach that will protect the interests of all access users, and at the same time ensure the sustainability of USO.

2. RESEARCH METHODOLOGY

For the purposes of work, in order to develop a doctoral dissertation on the topic "Development of a model of access to the postal network," an analysis of the state of the postal market and overall postal infrastructure in the Republic of Serbia was done. The survey was conducted over a period of six months (from November 2014 to April 2015), and the participants were the National regulatory authority - RATEL and 39 postal operators on the territory of the Republic of Serbia. The results obtained in this paper are useful for defining the mode of access and access points on the network public postal operator (PE Post of Serbia).

The main objective of the research was to use the analysis of the postal services market to determine:

- Communication way between postal operators and users of postal services;
- Methods of cooperation and partnership existing among postal operators;
- The level of infrastructure development and means of the network used by postal operators to perform postal activities;
- Future directions of development of infrastructure and the need to increase the availability of services and networks;
- The current situation and plans regarding an expansion of the range of services;
- Problems that exist in the provision of postal services and quality of services.

3. NETWORK ACCESS IN EUROPEAN COUNTRIES

Postal network of the public postal operator has a significant role in a liberalized postal market. The public postal operator has high network maintenance costs and does not use its postal network enough. In the paper (Miletić, 2013) it is specifically stated that the increasing competition is very important to encourage current operators to become more efficient in order to maintain a high level of quality of services from the scope of universal services. The paper also states that increasing competition may directly endanger the existence of the public poslal operator. Therefore, regulators must take into account the different views and create such a model access that will be functional for both the public postal operator and other access users i.e. postal operators, consolidators and users who only submit their shipments (Ordinance, 2014; 2016).

According to relevant papers (Miletić, 2013; Dieke et al., 2013; Jaag, 2014; ERGP, 2012; ERGP, 2013) it can be concluded that on a fully liberalized postal market postal operators can use two basic models of access: upstream and downstream access. Downstream activities imply local network for delivery of postal items, while everything else is considered as upstream activities. Upstream activities are often referred to as “worksharing” and include activities of acceptance, grouping, sorting and stamping, before accessing the public postal network. Accessing the public postal operator network, access users are given an opportunity to fully or partially use the public postal operator network (Jaag, 2014).

Crew and Kleindorfer (2002; 2003), Panzar (2002), Moriarty and Smith (2005) discussed the advantages and disadvantages of downstream access. All the authors agree that regulation of downstream access may facilitate the entry of postal operators on the market, but also most agree that such a policy could have additional costs.

According (HR Strategy, 2014), upstream activities include working operations of collection, sorting and transport of items, while downstream activities include working operation of delivery of items (Figure 1).

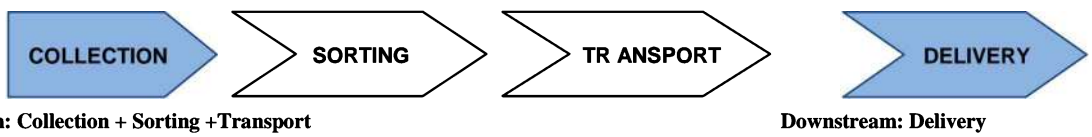


Figure 1: Upstream and downstream activities in the chain of transmission of postal items

In addition to these authors who have described and discussed models of approach, in Republic of Serbia there were a number of analyses and discussions regarding the access to the postal network. Thus, for example, in the paper (Kujačić et al., 2013) it is pointed out that access should be a balance in terms of

providing the universal postal service, since the public postal operator has an obligation to provide it, unlike its competitors. It also states that operators entering the market need to have a network access (especially in rural areas). According to (Gezović Trubint, 2011) regulation of access is one of the important steps in the process of market liberalization which should protect users' interests an densure the provision of universal postal services throughout the territory of the Republic of Serbia, under the same conditions and affordable prices and required standards of quality. The paper (Unterberger et al., 2015) describes various models of access in the Danube region, with the analysis of the efficiency of the public postal operators that provide access to the postal network.

As can be seen in Table 1, which shows the extent of access in European countries after the date of liberalization, Germany, United Kingdom and Slovenia are the only countries that have more than 5% of access to the postal network. The speed of liberalization of the postal market has varied: since January 1st 2011, 13 Member States (Austria, Belgium, Bulgaria, Denmark, Estonia, Finland, France, Germany, Ireland, Slovenia, Spain, Sweden and the UK) have fully liberalized their postal markets. Switzerland has maintained a reserved area up to 50 g, while the Republic of Serbia has maintained a reserved area up to 100g (ERGP, 2012).

Table 1: Dates of liberalization and scope of access in European countries.
(ERGP, 2013; Postal Regulatory Database, 2013)

Liberalized their market before EU deadline	**Liberalized their market by the deadline, in 2011.**	**Liberalized their market between 2011 to 2013.**	**Did not fully liberalized their markets to 2015.**
More than 5% competition access			
Germany (10 %) **United Kingdom (44 %)**	**Slovenia (7,6 %)**		Cyprus Norway **Serbia** Świtzerland Italy
Less than5% competition access			
Estonia Finland The Netherlands Šweden	Austria Belgium Bulgaria Denmark France Ireland	Czech Republic Greece Hungary Latvia Lithuania Malta Poland Portugal Romania Slovakia Croatia	

Italy is a member of the EU, but until 2015 the access was not regulated. In Switzerland, the Access to post office boxes in the destination post office and to database with addresses was provided. **In Serbia**, at the end of 2014 the *„Ordinance on the methods and conditions of access to the postal network of the public postal operator" was adopted, and* the *„Ordinance on special conditions for access to postal network " was adopted* in March 2016. **Cyprus** provides the access to the public postal operator through: units for providing customer service (post offices), post office-boxes and letter-boxes, although the market is not yet fully liberalized (ERGP, 2013). **In Norway**, the Law regulates the access (ERGP, 2013), although there is no information whether and to what extent is the access to the postal network implemented (Postal Regulatory Database, 2013).

In Slovenia, full liberalization happened in 2011 and it has led to the emergence of competition on this market with the entry of four access users. Currently, the main job of these oparators is printing and preparation of accounts. On the Access market, about 7.6% of the total number of letters addressed is handled byAccess users, while the remaining 92.4% is handled bythe public postal operator. **In Germany**, there are numerous active companies on the market, which mainly operate as consolidators and postal operators, which conclude agreementson access to postal centers for sorting items. There are five postal operators (Access users), which handle 10% of the total volume of letters on the postal market.

More than half of the countries included have a legal requirement for access to the postal network (in postal centers), but most countries have a legal requirement for access to the postal infrastructure (eg. The system of postal address code, database for shipments routing,data on change of address, letter-boxes) (Miletić, 2013). All the three countries in which there is more than 5% of competition havea legal obligation of access to the postal network, while Slovenia and the United Kingdom have a legal obligation to provide conditions for access to the postal infrastructure to varying degrees.

Only the three countries that have opened their markets within or before the deadline of the EU, have a greater scope of access than the countries that have opened up their markets after 2011.

3. ANALYSIS OF THE CURRENT SITUATION ON THE POSTAL SERVICES MARKET

Postal services have a key role in the economic and social development of each country, being a priority due to their multiple benefits for businesses and citizens. According to the data, in 2014, the postal sector had 17,630 employees, which is approximately 1% of the total number of all employees in the Republic of Serbia (RATEL, 2015b). Since the National regulatory authority (NRA) was formed in 2010, until 2014 there is a constant growth the number of postal operators in the market of the Republic of Serbia, as well as the growth the number of employees in this sector. This growth is as high as 50%, as shown in Table 2.

Table 2: Number of staff in the postal sector in the Republic of Serbia (RATEL, 2015b)

	2010.	2011.	2012.	2013.	2014.
Public postal operator	14981	14939	15068	15155	15015
Postal operators	1747	2048	2618	2464	2615
TOTAL	16728	16987	17686	17579	17630

Analyzing the public postal operator in Serbia, based on available data of the Universal Postal Union (http://www.upu.int/en/resources/postal-statistics/query-the-database.html), brings forward the following conclusions:

- If we look at **the resources** available to the PE Post of Serbia, there is a decline in the number of staff and number of post offices, with a higher decline in staff than the number of post ofices, which is a characteristic of the postal market in other European countries. There is also a large decrease in the number of mail-boxes (by 49.45%) and a small increase in the number of post office-boxes (2.68%);
- Looking at the number of different **postal services**, the analysis showed that in Serbia there is a 6% drop in the number of letters. It is important to note that the number of items of direct mail (addressed and unaddressed) is three times bigger, the number of express items five times and the number of ordinary money orders is two times bigger than it was;
- **Financial indicators** recorded a decrease in net revenue and revenue from letters and financial services;
- **Quality parameters**, expressed for example: „*Average area covered by a permanent office* (km²)", „*The percentage of the population having mail delivered at home", „Percentage of items delivered through post office boxes"* and „*Average number of letter-post items posted per inhabitant*", on an annual basis. *Percentage of items delivered through post office boxes*drops every year. In 2014 it was 16.2%, which represents a 22.85% less coverage than in 2005. *The percentage of the population having mail deliverred at home*in the last few years is without significant changes, as a quality parameter has a satisfactory value of 98.5% (according to the quality parameters shown in RATEL, 2015a).

Analysis of the postal services market was carried out in cooperation with the NRA - RATEL. Postal operators have submitted a survey / questionnaire containing three groups of questions, with a total of 21 questions:

- The first group of questions was related to general information about the postal operators, customers and business partnerships of postal operators and consisted of 7 questions;
- The second group of questions was related to infrastructure and access to services and networks, and consisted of 6 questions;
- The third group of questions was related to the range and quality of services (8 questions).

The questionnaire distributed to postal operators electronically is shown in Table 3.

Table 3: The structure of the questionnaire for postal operators

Parts of the questionnaire	Asked Questions
I **General data, users and business partnerships**	1. Postal services as a main activity 2. Total annual turnover - "VAT system" 3. Cooperation with other operators 4. Percentage of the provision of services of another operator 5. The most common way to communicate with customers 6. Availability of "Special Conditions for the provision of postal services" 7. Method of communication with customers
II **Infrastructure and access to services and networks**	1. The number and type of vehicle 2. Equipped means for receiving items 3. Territory operation ie. provision of services of postal operators 4. Places that may not be covered for that there was a need 5. The number of items that operators cannot collect from the user, as well as reasons for failing to collect them (if any) 6. Planned investments for the future
III **Range and quality of services**	1. Expanding the range of services 2. Planning of new services 3. The territory that operators can not cover the need to have 4. Reasons for not collecting items from the sender 5. The percentage of delivered items within the guaranteed delivery date 6. Number of complaints 7. The average time for solving complaints 8. Average compensation paid in dinars

4. RESEARCH RESULTS

Out of the 39 postal operators who participated in the survey, only 13 operators submitted the answers, which is 33.33% of the total number of registered postal operators in Republic of Serbia. Based on their analysis, the following conclusions were made:

- Main business activity of majority of postal operators is postal services (61.53%);
- Majority of postal operators is located within VAT system (the VAT system in Republic of Serbia are those operators that have an annual turnover in excess of 8 million dinars);
- Communication with users is established in many ways. The most common way to communicate with customers is by using Mobile or landline (34%), followed by the use of electronic e-mail messages (26%), call center (24%) and direct contact (16%) (Figure 2);
- Majority of operators cooperate with the public postal operator (PE Post of Serbia);
- Only 3 postal operators achieve more than 30% of their business by using other postal operators, mostly the public postal operator;
- With 92.30% of postal operators “Special conditions for the provision of postal services" are available to all users;

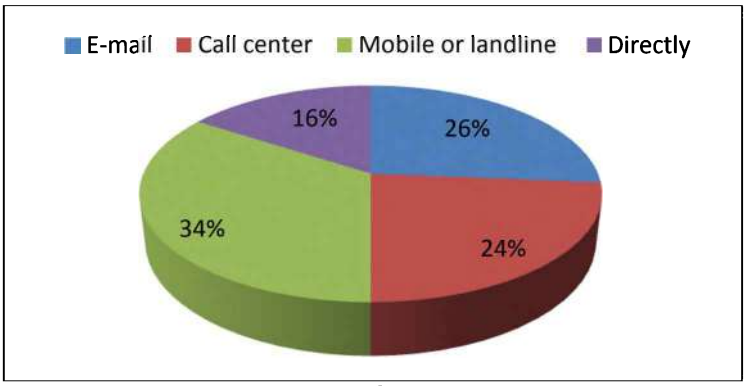


Figure 2: Way communication of postal operators with the users

- Trucks over 3.5t, cars and mopeds are mostly used for transport of items, while trucks over 12t and buses are less used (Figure 3).

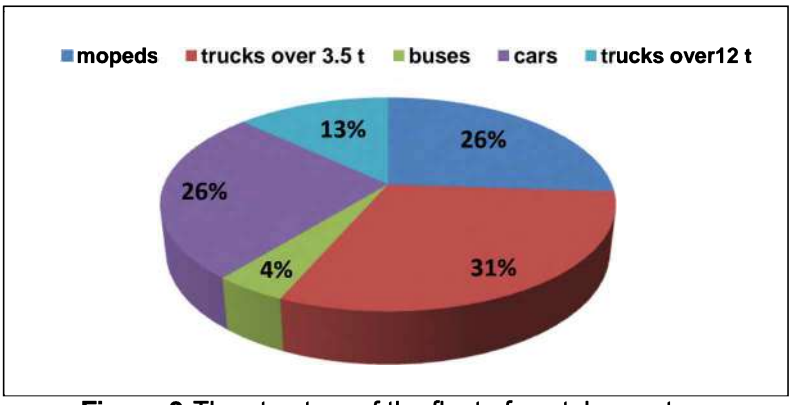


Figure 3: The structure of the fleet of postal operators

- Other means of postal network include scanners and scales, and rarely means of internal transport (forklifts, conveyors, belt conveyors);
- 5 postal operators conduct their business in the whole territory of Serbia, 5 conduct their business in the the territory of Vojvodina (22%), while the others operate on the territory of Belgrade (48%) and Europe (8%) (Figure 4);

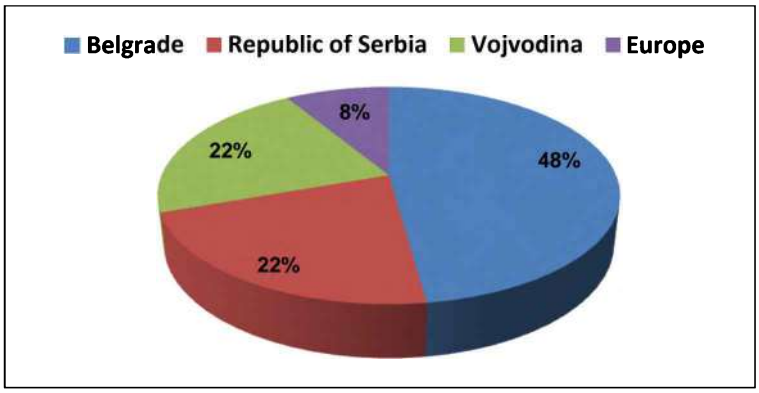


Figure 4: The territory of operation of postal operators

- 92.30% postal operators responded that there is no need to increase the availability of their services and networks;
- Majority of investments by postal operators is spent on the equipment and less is designated for employee training;
- Majority of postal operators do not plan to increase the range of services, and none of the operators plans to provide universal postal services;
- The level of service quality is satisfactory, which is shown by the percentage of delivered items in a guaranteed period of time, and the number of complaints.
  If we observe the delivery of the consignment to a guaranteed period of time, as one of the main indicators of the quality of postal services (Figure 5), the largest number of operators realized delivery of 100% - 37% of postal operators, and the lowest percentage of delivery (90%) occurred in 26% of operators.

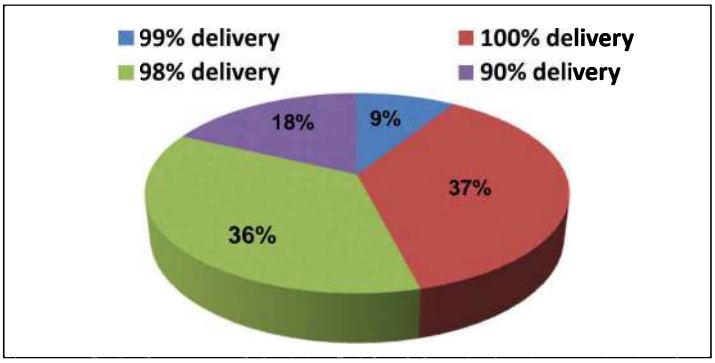


Figure 5: Percentage of delivery of items within the guaranteed period

- The average time for solving complaints is 2.33 days, while the average paid compensation is 4,923.00 dinars.

Operators who did not give answers were contacted by telephone.They mentioned several important reasons why they had failed to submit their responses. The most common reasons why operators did not submit their answers are shown in Figure 6. It is noted:

- that 21% of postal operators are dissatisfied with their position on the existing public operators monopoly market;
- 8% of the operators state that the main reason why they did not provide answers is that the market is not yet fully regulated, and it is precisely these operators who have focused their operations on the transfer of consignments in international traffic;
- 18% of operators believe that they have insufficient cooperation with the regulator, and as many as 20% are of the opinion that "access to the postal network will not significantly impact on their business" (the reason for such an opinion could be attributed to lack of information by the Regulator).

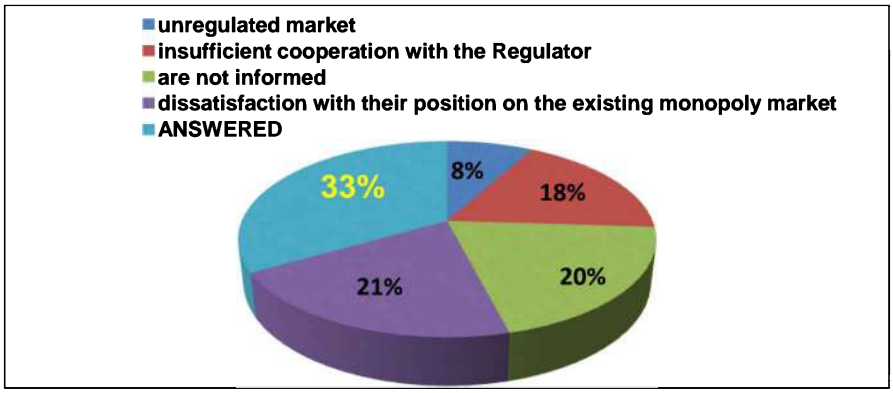


Figure 6: The most common reasons for not receiving appropriate by the postal operators

5. CONCLUSION

In Republic of Serbia, the access to the postal network, based on two key documents, namely*„Ordinance on the methods and conditions of access to the postal network of the public postal operator", and "Ordinance on special conditions for access to postal network".* Analysis of the research results points to the fact that few postal operators plan to increase their services and network availability. Consequently, there are operators interested in providing a set of postal services in the domain of universal postal services. Studies have shown that in 61.53% of operators main business activity of majority of postal operators is postal services

A small number of postal operators have cooperation with other operators. Only few operators have collaboration with PE Post of Serbia, in the field of commercial services. Postal operators are able to transfer items, as confirmed by the structure of their vehicle fleet, which indicates that most operators have trucksup to 3.5 t and cars. This creates a possibility for downstream access to the postal network in units to provide customer service (post offices) and in units for sorting items (postal centers). When it comes to quality of execution services, it is pointed out that 82% of the analyzed postal operators have more than 97% of the guaranteed delivery of items within the delivery date.

The analysis of the postal services market haspointed out the following factors which directly influence the market of postal services.:

- **The existence of a reserved area** for letter-post items up to 100 grams, which provokes the question: Does the existence of the reserved areas affect market development in the Republic of Serbia?
- **Uncertain regulation**, as well as a partial regulation of the market. In connection to this, it is necessary to reduce the impact of uncertainty through coordinating the dates for full liberalization of the market, and the adoption of other important documents, in addition to the already passed Ordinancesin 2014 and 2016.
- **Insufficiently informed postal operators**, insufficient cooperation with NRA - RATEL, as well as operators'**dissatisfaction** with their position on the existing monopoly market.

Identified factors are just the basic factors that can be of great influence on the access to the postal network, and whose impact needs to be further explored in order to be able to define an adequate model of access to the postal network in the Republic of Serbia.

REFERENCES

Crew A. M., Kleindorfer R.P.(2002). Balascing Access and the Universal Service Obligation, Delivering on competition, Topics in Rregulatory Economics and Policy

Crew M.A. (2003), Kleindorfer P.R., 'Balancing access and the Universal Service Obligation', in M.A. Crew and P.R. Kleindorfer (eds), Postal and delivery services: Delivering on competition, Kluwer Academic Publishers, 3–32.

Dieke Kalevi Alex, Christian Bender, James I. Campbell, Jr. Robert H. Cohen, Christine Müller, Antonia Niederprüm, Alexandre de Streel, Sonja Thiele, Claus Zanker (2013). Main Developments in the Postal Sector (2010-2013), Wik-Consult, Final Report, Bad Honnef, Germany

DIRECTIVE 2008/6/EC of the European Parliament and of the Council

ERGP on "access" to the postal network andelements of postal infrastructure (2012)

ERGP report on end-to-end competition and access in European postal markets (2013)

Gezović S, Trubint N. (2011).The change of postal regulator role in liberalized market conditions, XXIX Symposium on novel technologies in postal and telecommunication traffic, Proceedings, Faculty of Transportation in Belgrade, Belgrade, 167-174.

Kujačić M., Jovanović B., Dumnić S.,Trubint N. (2013).Regulation of access to public postal network, XXXI Symposium on novel technologies in postal and telecommunication traffic, Proceedings, Faculty of Transportation in Belgrade, Belgrade, 155-162.

Miletić R. (2013). Access to the postal network in liberalized postal services market, XXXI Symposium on novel technologies in postal and telecommunication traffic, Proceedings, Faculty of Transportation in Belgrade, Belgrade, 145-154.

Moriarty R., Smith P. (2005). Barriers to Entry in Post and Regulatory Responses, In Regulatory and Eeconomic Challenges in the Postal and Delivery Sector, edited by M.A Crew and P.R. Kleindorfer, Boston, M.A: Kluwer Academic

Panzar J.C.(2002). Reconciling competition, downstream access and universal service in postal markets', in M.A. Crew and P.R. Kleindorfer (eds), Postal and Delivery services: Delivering on Competition, Boston, M.A: Kluwer Academic, 93-118.

Postal Regulatory Database (2013), Internacional Post Corporation

Ordinance (2014): Ordinance on special conditions for access to postal network, Official Gazette of RS, number 146/14

Ordinance (2016): Ordinance on special conditions for access to the postal network, Official Gazette of RS, number 1037.

RATEL, The research model of Universal Service Obligation, (2015b)

RATEL, Report on Quality of Universal Service Obligation for 2014, (2015a)

Strategy development of postal services in the Republic of Serbia from 2013 to 2016, Official Gazette of RS br. 43/13

HR Strategy (2014): Strategy for the development of postal services in the Republic of Croatia until 2020, The Ministry of Sea, Transport and Infrastructure, Zagreb

Unterberger M., Šarac D., Jovanović B. (2015). Overview models access to the postal network in the Danube region, Proceedings: The 4 th Internacional Conference, Danube Business Forum - Competitiveness and Sustainable Development, 65-69.

Jaag C.(2014), Postal-Sector Policy: From monopoly to regulated competition and beyond,Utilitiles Policy, Elsevier

http://www.upu.int/en/resources/postal-statistics/query-the-database.html

MEASURING SECURITY MANAGEMENT PERFORMANCE

Dragan Bojanić
University of defence
*Corresponding author, e-mail:dragan.bojanic@mod.gov.rs

Abstract: *Performance management is at the heart of most modern organizations, whatever their purpose and irrespective of whether they are privately or publically owned. It is only through the measurement of performance that an organization can demonstrate to itself and its stakeholders that it is achieving its goals, which most commonly include financial, operational, safety security and environmental performance. The crucial role within management and control of security systems should be played by top management, i.e. the key element in this process is the responsibility of security and safety management system.*

Keywords: *security, management system, performance, measurement, efficacy*

1. INTRODUCTION

Preventing and mitigating the effects of external and internal threats are always current problems in almost every organizational system. Therefore, if not all, but most of organizational systems must be designed to include safety in their plans. In fact, people who are working to develop a security management must take into account other objectives of the system, or to choose dual alternatives that offer additional benefits for business owners. It is therefore of great importance that security is viewed in the context of the broader system.

Many organizations in developed countries apply a systematic approach in solving security problems. In most of such companies, a security management system has been introduced and it protects the organization from their own mistakes. However, methods for determining the performance of the security management system, or to measure its effectiveness and efficiency, are not sufficiently developed. The main problem, lies in the fact that in many countries, safety standards which organizations must adhere to, are still not equally and clearly defined, and they should represent a landmark for identifying the safety targets. Therefore, different methods are used for determining the deviation from the norm. In addition, there is a problem that relates to the "profitability" of security management. If security is not set as a strategic, general and basic goals of the organization, its importance cannot be explicitly expressed. The goal of security management actually is that "nothing happens". Although it is difficult to measure the safety and sometimes even seems impossible, yet it is the only reliable way to answer the question of whether an organization is able to solve security problems, and to successfully cope with security risks.

2. THE TERM AND SYSTEM OF SECURITY MANAGEMENT

The term "security management" is relatively recent, so we can say that there is still no definitive definition. The very concept of security management in a broader sense means Dragišić (2007) "determination of the safety objectives of the organizational system, on ways and means to avoid the adverse impacts that come from the environment or the organizational system, or to mitigate their adverse impact" (p. 14), while the Italian and Slavković (2011) defined it as "guiding activity of the industry leaders in the field of security, which leads security forces in the process and towards achieving security goals and tasks" (p.298). A more detailed definition is given by Borodzicz (2005) 'security management includes management of safety and health in the workplace, audits, crisis management and planning for emergency situations, video surveillance, harassment in the workplace and mobbing, track employees, equipment and people for physical security in fact everything that can affect the functioning of the organization, its profitability and vitality. "(p.50).

Various challenges, risks and threats that organizations exposed to, and organization's responsibility towards the environment in terms of safety, have a crucial impact on security management, and the way in which decisions regarding security will be made. In addition, Fowler and Pierce (2012) say that "security in itself is not an attribute, but it is a trait of systems that depend on other attributes and the context in which the system is used" (p.115).

According to Trivan (2012) security management system in the company, in addition to the physical and technical protection of persons, property and operations, must involve in itself: data collection and risk assessment, protection from fire, explosions and accidents, protection and safety in the workplace, but also it

forms the basis for management decision-making, providing access to confidential information to top management and establish processes and procedures for the protection and security of data (p. 227-236.). Thus, this system has to integrate all aspects of security and protection.

System security management can be understood as a set of policies, strategies, processes, procedures, roles and functions related to safety. This is a mechanism that is integrated into the organization and aims to control hazards that may affect the health and safety of employees, products and services, but also on the environment and the survival of the company. At the same time, this system allows the organization to adapt more easily to the legislation. In order for the security management system to be efficient and effective, it must be accepted and fully applied by employees. Therefore, the system must promote the positive security climate, or culture. Therefore it is necessary that all levels of management, and in particular top management, support and promote a system of security management

3. PERFORMANCE OF SECURITY MANAGEMENT SYSTEM

Working in a complex environment requires substantial resources and may affect the profitability of the organization. Protection of the financial condition and stability of the organization is one of the main issues tackled by management. All this leads to great challenges for many activities within the organization, especially for security management. Costs directly affect the organization's operations, and therefore they receive great attention. Given the dynamic changes in the modern environment, it is clear that every organization that wants to survive, must think in along term about way of investing the funds. To be able to monitor the efficiency of investments, according to Christophers, Carino, and Ferson, (2009), the organization introduced performance management processes and control operations, and for this there must be clearly defined indicators (p. 5). According Dochy, Segers and Wijen (1990) indicators are empirical data of qualitative and quantitative nature. These data become indicators of performance if the participants express the intended targets in a process (p. 135). This gives them the contextual and temporal character..

Performance are mainly monitored over the following six basic criteria: effectiveness, efficiency, quality, timeliness, productivity and security. However, every organization shapes these measures according to their own needs. Therefore, in the performance measurement of the system security management, we have decided on the efficiency and effectiveness as such basic indicators of successful operation of the system. The biggest problem in this regard is the lack of an accepted and measurable indicators which would indicate a return on investment. It's little of what the organization can do in this area. Measurements are often made in the context of avoiding incidents or influence of perceived risk (for example, the impact would be less than the cost of controls and therefore provides a positive rate of return.

Performance of organization indicate the effectiveness of its operations, and for this reason, measurement of its performance is performed. Thus, the performance of the process can be translated as the effect or success of the process, but it must express some size. Measuring performance literally means the process of quantifying past activities, or a set of criteria that are used to quantify the efficiency and effectiveness of activities. From the point of this work, I decided to show performance measurements by quantifying the effectiveness of the action.

4. MODEL FOR ASSESSING THE EFFICIENCY OF SECURITY MANAGEMENT

The purpose of an organization is reflected in her mission, through which one could recognize the core business, and it contained all the requirements of all stakeholders. The mission is translated into goals and then processes and activities are defined that are necessary to achieve them. The degree to which the objectives are met, and thus the mission itself, shall be determined by measuring and comparing with the set target. Comparison of actual and established performance values of a process or the organization itself with the desired value can lead to a change in the mission of the organization.

There are four basic steps to establish a performance measurement system (figure 1):
- Security objectives of the organization are converted to the desired standards,
- Development of the criteria that allow the comparison of the desired safety standards with the achievement of the security situation,
- Determination of the deviations,
- Taking corrective action.

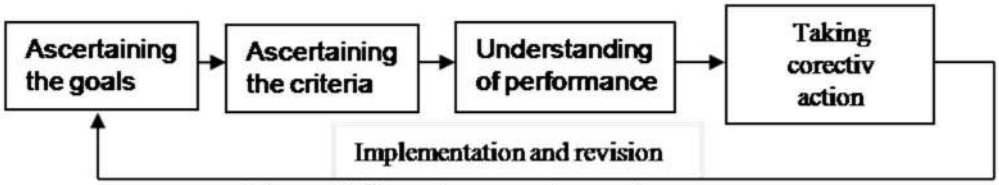


Figure 1. Steps in measuring performance

Measurement is a set of actions with a view to determining the value of a size. Definition of measurement given by Milosavljević, Radosavljević (2013) suggest that the measurement is procedure of systematic determination of the quantitative properties of a phenomenon by defined and appropriate measures and standards (p.571). Performance measurement process, therefore, may relate to determining the value or performance of the process. If the process is defined as a set of interrelated activities that transform inputs into output, then the output of the key elements of process are safety reports and assessments, and the input are plans, objectives, funds invested. The measure of performance is always in relation to the objective, which is the desired state, and the desired value performance. The value of performance can be expressed through a one dimensional measurement unit (time, the dollar, the number of reports, the number of errors and the like.), which typically represent the basic criteria of a process. The measurement process of the safety performances can't be conceived as a simple collection of data, but must be viewed solely as the overall management system that is focused on meeting the demands of all stakeholders and continuous improvement.

Model should provide to any manager, especially to security managers, the kind of information necessary to make high quality and timely decisions. In addition, this model should be a system that should enable the organization to accumulate knowledge about their customers, processes and resources and implement continuous improvements in security, ensuring the survival, growth and development of the organization.

4.1The algorithm for measuring the effectiveness of protection in systems security management

Based on the models which are set by prof. Petrović L. and Z. Petrović, we present an algorithm that looks at the effectiveness of protective measures in security management systems. According to the model that Petrović and Petrović gave (2002) "state of the organizational system can be represented by a matrix sheet [S_{rs}], the situation at the entrance to the system can be represented by a matrix of input [X_{ij}], and at the exit, matrix output states [Y_{pq}]. On the organizational system is operating activities endangering that can present matrix compromising [U_{mn}]. The elements of this matrix represent the demonstrated effects compromising ***m*** acting on n elements of the organizational system. After compromising effects manifested in the system apply certain safeguards, which are represented by a matrix of protection [Zk_n]. The elements of this matrix represent the number of protection measures (k) applied to the n elements of the organizational system" (p.2-6).

In the proposed model, the state of the system is best represented as follows:

1. The set of elements of the organizational system consists of a number of organizational units, jobs and the final number of participants end (1),

$$[S]=[S_{od}, S_{rm}, S_{ku}] \quad (1)$$

wherein:
S- set of elements of the organizational system
S_{od} - the total number of organizational units,
S_{rm} - the total number of working places,
S_{ku} - final number of final participants

2. Environment operates with **m** different forms of threat on organizational system. A set of expressed compromising effects presents a matrix of endangering [U_{ij}]. The set of expressed endangering effects are:

$$[U] = [FU, U_{žs}, P, UI] \quad (2)$$

wherein:
U - a collection of expressed compromising effects,
FU - physical endangerment of the organizational system,
$U_{žs}$ - endangering the environment,

P - fires
UI - endangering information system in the organizational system. Matrix effects manifested compromising $[U_{mn}]$ can be written as:

$$[U_{mn}] = \begin{pmatrix} u_{11} & u_{12} & - & - & - & u_{1n} \\ u_{21} & u_{22} & \cdot & \cdot & \cdot & u_{2n} \\ & & & & & \\ u_{m1} & u_{m2} & \cdot & \cdot & \cdot & u_{mn} \end{pmatrix} \quad (3)$$

Elements of matrices u_{ij} be zero if the j -th element system u_{ij} manifested i-th effect compromising, otherwise it is equal to one.

3. In the organizational system, safeguards were applied that can be presented matrix applied measures of protection $[Z_{kn}]$, which can be written as:

$$[Z_{kn}] = \begin{pmatrix} z_{11} & z_{12} & - & - & - & z_{1n} \\ z_{21} & z_{22} & \cdot & \cdot & \cdot & z_{2n} \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ z_{k1} & z_{k2} & \cdot & \cdot & \cdot & z_{kn} \end{pmatrix} \quad (4)$$

Element matrix applied measures of protection z_{ij} is equal to zero if the j-th element of the system has not been implemented i-protection measures, otherwise it is equal to one.

4.The state of the system at the exit of the system [Y] is determined by the parameters of forming the [X] and the current state of the system [S]. Current status depends on the threat to [U] and the measures of protection that are defined matrix of protection [Z].

5. Matrix System status [S] can be determined as the product of a matrix of endangerment and protection of dies (4):

$$[S_{mk}]=[U_{mn}]x\ [U_{kn}] \quad (5)$$

Respectively

$$[S_{mk}] = \begin{pmatrix} s_{11} & s_{12} & \cdot & \cdot & \cdot & s_{1k} \\ s_{21} & s_{22} & \cdot & \cdot & \cdot & s_{2n} \\ & & & & & \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ s_{m1} & s_{m2} & \cdot & \cdot & \cdot & s_{mk} \end{pmatrix} \quad (6)$$

It is the glow of <S, and if they did not neutralized the effect of compromising the j-th measure of protection and $s_{ij}>S_u$ otherwise S is the mean value obtained by the matrix elements of the system status.

If the amount of the matrix sheet is less than the mean value obtained by the matrix elements of the system status, it means that the effect of compromising, which is manifested in any element of the organizational system, it is not neutralized by the application of protective measures in a given element of the organizational system. If the amount of the matrix sheet is greater than the mean value obtained by the matrix elements of the system status, it means that the effect is manifested compromising on any of the elements of the organizational system neutralized by applying protective measures in a given element of the organizational system.

In a real situation, the manager can form a matrix compromising on the basis of data obtained from security assessments, as well as the matrix of protection based on the knowledge of the security system, and

implementation measures. Using this algorithm, it is possible to quickly reach the information that applied protection measures can counteract the effect of the manifest danger or not.

5. CONCLUSION

Models for assessing the effectiveness of security activities in organizations in Serbia have not been developed, and the only indicator that executives use the service cost is the price of safety. That is, the top management in most organizations decide on how to organize the security system on the basis of costs involved in its organization and functioning. Very rarely take into account the costs that would be incurred in the event of an incident. Therefore, it is necessary to determine the method for determining the effectiveness of the security management in order to point in the clear way to the essence of its existence, but it is actually its main goal, and that is, survival, smooth functioning, growth and development of the organization itself.

REFERENCES

Borodzicz, E. P., (2005) Risk, Crisis and Security Management, John Wiley & Sons Ltd., Chichester.

Christophers, J. A., Carino, D. R., Ferson, W. E., (2009) Portfolio Performance Measurement and Benchmarking, McGraw Hill Companies Inc., New York.

Dochy, F., Segers, M., Wijen, W., (1990): Selecting Performance Indicators. A proposal as a result of research, in Goedegebuure, L., Maassen, P. & Westerheijden, D. (Eds.) Peer Review and Performance Indicators (Utrecht: Lemma. B.V.,)

Dragišić, Z., (2007) Bezbednosni menadžment, Službeni glasnik RS, Beograd,.

Fowler, D., Pierce, R., (2012), Safety Engineering - a Perspective on Systems Engineering, Achieving Systems Safety, Springer-Verlag, London.

Milosavljević S., Radosavljević I., (2013), Osnovi metodologije političkih nauka, peto izdanje, Službeni glasnik, Beograd.

Petrović, L., Petrović, Z., (2002) Algoritam zaodređivanje efikasnosti mera zaštite u funkcionalnim telekomunikacionim sistemima, 10.Telfor, Beograd.

Talijan M. &Slavković R., (2011). Područja odbrambene delatnosti kao predmet istraživanja bezbednosnog menadžmenta, Vojnodelo br. 3, Beograd.

Trivan, D., (2012) Corporate safety in the Republic of Serbia: overview and prospects, Corporate security in dynamic global environment - challenges and risks, Institute for Corporative Security Studies, Ljubljana.

Willis, A., Watson, B., Biggs, H. C., (2006), Comparing safety climate factors as predictors of work- related driving behavior, Journal of Safety Research, Volume 37, Issue 4.

MILLENNIALS AS A FUTURE DOMINANT WORKFORCE - STRATEGIC FRAMEWORK FOR UNDERSTANDING AND CREATING CHALLENGING ENVIRONMENT

Tanja Ilić*[1], Milica Pavićević[1]
[1]Faculty of Organizational Sciences
*Corresponding author, e-mail: tanja.ilic.94@gmail.com

Abstract: *The purpose of this research was to explore and define key characteristics that distinguish the generation of Millennials, workforce that will represent 50% of the global workforce by 2020 and to define strategic framework for creating an organization which is desirable employer. The paper presents evaluating results on key elements that constitute challenging and enriching workplace environment, according to Millennials, which encourages them to thrive and give their best. This paper presents theoretical and practical overview and comparison of Millennials' expectations, both in Serbia and worldwide. The research showed that in order to attract and retain Millennials at workplace, employers should create a flexible work culture, build a sense of a community through teamwork and provide a constant feedback. In addition, organizations should embrace new technologies and social networks, encourage learning and allow faster advancement. Foundationally, it is essential to understand the Millennials' mindset and reshape the world of work in accordance with the expectations of this new workforce entering the employment.*

Keywords*: strategic management, Millennials, Millennials' traits, shaping organization, workplace, workplace engagement, research*

1. INTRODUCTION: MILLENNIALS. WHO ARE THEY?

The Millennial generation, also known as Generation Y, Net Generation or Generation Next, is generation that follows Generation X. Millennials are, according to the PwC survey (Millennials at work – Reshaping the workplace, 2011), those born between 1980 and 2000. They are now entering the workplace and reshaping it toward their needs. Their career objectives, ambitions, attitudes about work and, in general, their mindsets will have a huge influence on the working world in the future years.

Millennials were identified as "digital natives" in the Pew Research Center's survey *Millennials in Adulthood* (2014). As Bannon, Ford and Meltzer (2011) point out Millennials are more technologically savvy and better educated than the previous generations. The PwC survey (2011) suggest that "they have grown up with broadband, smartphones, laptops and social media being the norm and expect instant access to information", which implies that "one of the defining characteristics of the Millennial generation is their affinity with the digital world".

Besides being tech-savvy, there are other characteristics that are defining the Millennial generation. As DeVaney (2015) puts it "traits attributed to the Millennials include: entitled, optimistic, civic minded, close parental involvement, values work-life balance, impatient, multitasking, and team oriented. As found in many surveys, Millennials are also described as sociable, talented, well-educated, collaborative, open-minded, influential, and achievement-oriented (Raines, 2002). What also distinguishes Millennials from the previous generations is their desire "to feel like they are a part of something and that they can make a difference in the world and workplace" (Spano, 2015).

Millennials are also described as "selfish generation" by some; and as we can see from the PwC survey (2011), they have "ambition and desire to keep learning and move quickly upwards through an organization", "they want to feel their work is worthwhile and that their efforts are being recognized", but are willing to "move on quickly if their expectations are not being met". Wasley (2015) agrees by saying that Millennials have "unrealistic expectations about the workplace and a propensity to job-hop rather than settle for a career they find unfulfilling", and adding that they "value creativity and a flexible work environment over stability".

Influenced by the global Economic crisis, Millennials tend to value their personal needs more than those of the organization, as the PwC survey (2011) suggests. The PwC survey also shows that Millennials expect rapid progression, an interesting career, constant feedback, encouragement, but in the same time, they also want flexible approach to work.

We have conducted a survey among Serbian students, which will be presented hereafter, in order to see what they are looking for in an employer. The results we got are similar to those shown above. Namely, among most important criteria, when choosing an employer, are opportunities for advancement and learning, good working conditions (working hours, work-life balance etc.) and work environment (atmosphere at the workplace, collaboration, recreation opportunities etc.).

As found in Pew Research Center's article by Bruce Stokes (2015), Millennials represented 24% of the adult population in the European Union in 2013, and, on the other hand, they formed about 27% of the adult population in the United States in 2014. According to the PwC survey (2011), Millennials will represent half of the global workforce, by 2020.

It is clear that Millennials will have a huge impact on the organizations and on the way they operate. They will certainly influence many changes in the workplace, thus becoming one of the major challenges that employers need to deal with. That is why it is really important for companies to understand Millennials and to attract the best among them. The key is not to specifically target Millennials, but rather create work environment appealing to this generation.

2. THE MAIN TRAITS OF THE MILLENNIAL GENERATION

Combining the key findings from different surveys, we have identified a few distinct characteristics of the Millennial generation. These traits include their advanced technological skills, as well as their attitudes toward work and life balance, loyalty, social responsibility, development, collaboration, and diversity.

2.1. Tech-savvy

Millennials, the first generation to experience globalizing world, are often referred to as "digital natives". Being tech-savvy is one of the main characteristics of today's youth and that can be seen in many aspects of their lives. As Bannon, Ford and Meltzer (2011) point out "they grew up untethered - with wireless devices, workplace mobility, and texting—and remain connected with friends via social networks". According to the Pew survey (2010), about 75% of Millennials are members of an online social network.

Palmer (2015) states that "employees expect companies to use the latest technology and be committed to improving technology on a frequent basis", because "technology allows employees to work remotely; employees can work smarter, not harder by using technology, and technology allows managers to focus on the results through better data tracking versus the number of hours an employee is sitting in the office".

Employers usually criticize their employees when they are texting or connecting to some of the social networks. But Millenials are actually turning online social networks into business opportunities, observed Lancaster and Stillman (The M-Factor: How the Millennial Generation Is Rocking the Workplace, 2010).

According to the Pew survey (2010), a majority (56%) of Millennials think technology helps people use their time more efficiently. As found in the PwC survey (2011), more than 50% of the respondents use their own technology at work daily and 78% said that access to the technology they like to use makes them more effective at work. This survey (PwC: Millennials at work - Reshaping the workplace, 2011) also suggests that "Millennials will expect a workplace technology ecosystem that includes social networking, instant messaging, video-on-demand, blogs and wikis", because "these social tools will enable this generation to instantly connect, engage, and collaborate with cohorts and managers in ways that are natural to them, leading to better productivity across the enterprise".

2.2. Work-life balance

According to the Pew survey (2010), to Millennials, as well as to all the other groups, family matters the most, while fame and fortune are much less important. Both, the Generation Y and the Generation X place a higher value on family relationships than career goals.

Spano (2015) points out that "Millennials have become accustomed to flexible work styles and want to have a "life" outside of their careers". Moreover, Krupienski (2016) says that work-life balance is generally regarded as more important criteria than the compensation.

In Global Millennial survey (INSEAD, 2014), 58% of respondents said they would spend time with family if given the opportunity to prioritize. Bannon, Ford and Meltzer (2011) noticed that importance of Millennials' life goals such as spending time with family, having a healthy marriage, and being a good parent may cause transformation of the conventional (nine-to-five) working hours into a more elastic time frame; and that is

because they are "willing to trade security and stability for the ability to better integrate their professional and personal lives".

PwC's NextGen Study (2013) shows that "Millennials want more flexibility, the opportunity to shift hours—to start their work days later, for example, or put in time at night, if necessary", and not only Millennials want that, but other employees as well. Furthermore, Ludden emphasizes that retention rates have dramatically increased at companies that offer flextime or part-time telecommuting (Jennifer Ludden, *When Employers Make Room for Work-Life Balance*, NPR, 2010). That is why companies must focus on providing more flexible working schedules.

2.3. Loyalty-lite

The PwC survey (2011) shows that over 25% of the Millennial generation expects to have six employers or more, compared to only 10% in 2008. Why is that so? This survey explains: "Millennials have seen that corporate loyalty does not necessarily bring rewards or even long term security in today's economic environment". That is the reason why many Millennials are checking out new opportunities, even if they are not actively looking for a new job, which leads to these results: "38% of the Millennials questioned, who are currently working, said they were on the lookout for new opportunities, and a further 43% said they were not actively looking, but would be open to offers".

Millennials want to work in a workplace that meets their needs, and if it doesn't, they will not hesitate to leave the current organization. Krupienski (2016) also points out that Millennials are "more apt to move to the next job than older generations would have been", "if they feel that they are in a place where their personal values are not being satisfied".

Moreover, Millennials are not only willing to switch employers, i.e. to go to work for competitors, but also many of them have ambitions to create their own businesses, which makes it even harder for organizations to keep them engaged. Therefore, employers certainly need to make an effort to understand Millennials' needs and desires, in order to attract them, on the one side, and to decrease the turnover rate, on the other side.

2.4. Social responsibility

Although Millennials are often described as selfish generation, that is not completely true. On the contrary, they are eager to help their communities and to feel useful. Pew survey (2010) reveals that many Millennials have a strong desire to contribute to their communities. Data shows that 88% of Millennials seek employers with social responsibility values that reflect their own. Many among the Millennial generation would accept to work for lower wage if their work contributed to the community, i.e. if they feel like they are doing something important and meaningful for the environment they are living in.

2.5. Development

The PwC survey (2011) indicates that „Millennials' desire to learn and progress is apparent in their view of the benefits offered by employers". They actually would like to get, as an award, training and development and flexible working opportunities more than financial benefits. This survey also suggests that „Millennials expect to keep on learning as they enter the workplace", and that opportunities for learning are very important criteria when choosing an employer, but also among the benefits they value the most.

Palmer (2015) says that Millennials are in constant need of getting a feedback on their performance. As found in the PwC survey (2011): "One of the strongest Millennials' traits is that they welcome and expect detailed, regular feedback and praise for a job well done – 51% of those questioned said feedback should be given very frequently or continually on the job and only 1% said feedback was not important to them".

Esoda (2013) emphasize that Millennials require immediate recognition for their accomplishments, especially because of the emerging usage of social media. Palmer (2015) points out that Millennials "want to constantly grow in positions, learn more, take on more responsibility, and know they are trusted to make profitable changes". Lancaster and Stillman (2010) have also mentioned that „whether they expect perks before others think they have earned them or they want to move up the career ladder in record time, Millennials have been labeled as entitled". The PwC survey (2011) reveals, likewise, that „career progression is the top priority for Millennials who expect to rise rapidly through the organization; 52% said this was the main attraction in an employer, coming ahead of competitive salaries in second place (44%)".

2.5. Collaboration

Lancaster and Stillman (2010) describe Millennials as generation raised in a time of team projects and group scores. Therefore, they are in need of a pleasant working atmosphere and good professional networks, which will enable them to keep up the team spirit. Krupienski (2016) suggests that Millennials want to have fun. That means that the work environment needs to be lively and positive.

Employers should make an effort in meeting the needs of this generation by creating a positive workplace. But employers also need to listen, meet with the Millennial workforce, seek and give feedback, mentor them, and take what they have to say seriously.

2.7. Diversity

Bannon, Ford and Meltzer (2011) explain that today's workforce is among the most complex, with many generations and cultures working together, and, therefore, business activities have become more globally connected than ever before. That brings a need for having intercultural communication skills. They also label Millennials as a diverse and inclusive generation. Thus, it is easier for the Millennial generation to imagine a world without boundaries: they want global experience and they are connected through social media with different people all over the world. Therefore, they are ideal candidates for international assignments. According to the PwC survey (2008), 80% of Millennials expect to work in other countries and 70% expect to learn and use a foreign language in their careers.

3. RESEARCH METHODOLOGY

Research was conducted in the February 2016, and with the sample of 192 students from the University of Belgrade, in Serbia. Data is collected using online questionnaire, which can be found on https://docs.google.com/forms/d/1By7ddgwL5XyScOETOHrAMOsGfC6zZC14SF_V50MSXxI/viewform, in Serbian language.

The main objective of this survey is to provide practical research about Millennials' view on how business should be performed and what are the main characteristics of employers that they seek and appreciate at work. Considering the fact that the Millennial generation has increasing share of the workforce, employers need to understand what Millennials overwhelmingly believe in - and that is business reset in terms of paying more attention to people and their needs.

Sample consisted of 192 respondents; most of them (59 (30.7%) out of 192) were students from third and (44 (22.9%) out of 192) students from second year of study. Further, 16 (8.3%) respondents were students of Masters and PhD studies, 32 (16.17%) students from first year, 36 (18.8%) students of fourth year of study, and the rest - 5 respondents, were students from fifth and sixth year.

Table 1: Sample characteristics	N (%)
Characteristics	
Year of study	
First	32 (16.7%)
Second	44 (22.9%)
Third	59 (30.7%)
Fourth	36 (18.8%)
Fifth	3 (1.6%)
Sixth	2 (1%)
Post-graduate (Masters and PHD studies)	16 (8.3%)
Sex	
Male	66 (34.4%)
Female	126 (65.6%)

Respondents in the target population of Millennials completed a total of 192 surveys, where male comprised 34.4% of the respondents, and female 65.6%.

The research results and discussion are presented in following section.

4. RESULTS AND COMMENTS

A survey and data analysis revealed important elements and criteria that contribute in creating a challenging, productive and motivating work environment for the next future leaders - students belonging the generation of Millennials. Following are the research findings.

Table 2: The most important criteria when choosing an employer	(%)
Opportunities for learning	(87.4%)
Opportunities for advancement	(92.1%)
Challenging assignments	(61.2%)
Working environment (atmosphere at the workplace, collaboration, recreation opportunities etc.)	(81.2%)
Good working conditions (working hours, work-life balance etc.)	(83.3%)
Team spirit	(52.4%)
Compensation	(83.2%)
Social responsibility	(50.8%)
International company/Prestige	(36.6%)
Organization's mission	(45.1%)
Springboard	(82.7%)

An analysis of the data collected from online survey, that was conducted among Millennials in Serbia, showed that the most important and respected factor mentioned by majority of respondents is opportunity for advancement with 92.1%.

Millennials in Serbia, as a future dominant workforce, recognize the full worth of opportunities for learning with 87.4%, as one of the leading criteria when choosing future employer or when evaluating existing.

Also, a quite large percentage, even 83.3% representatives of "Me generation", stressed that good working conditions relating to working hours and work- life balance, are key motivators for them. Following are criteria such as compensation with 83.2%, springboard with 82.7% and work environment with high level of collaboration, various opportunities for recreation and good working atmosphere with 81.2%.
Setting aside the previous chosen criteria, one of the key findings of this survey, that employers in Serbia can use in order to create inspiring work environment for Millennials, is the fact that 61.2% of respondents identified challenging assignments as one of the key drivers at work. This is not surprising since most young workers appreciate working on vitally important projects that allow them to expand their knowledge and use new skills (The Ken Blanchard Companies: Creating A Motivating Work Environment, 2009).
On the other hand, research has shown that young people in Serbia, who belong to this generation, in most cases, ignores international presence and prestige when choosing an employer, where 50.8% of them consider social responsibility more important factor.

5. COMPARATIVE ANALYSIS

To broaden our understanding of Millennials' expectations from work and how organizations should shape their work environment, we have compared the obtained results with those from Collegefeed Survey,

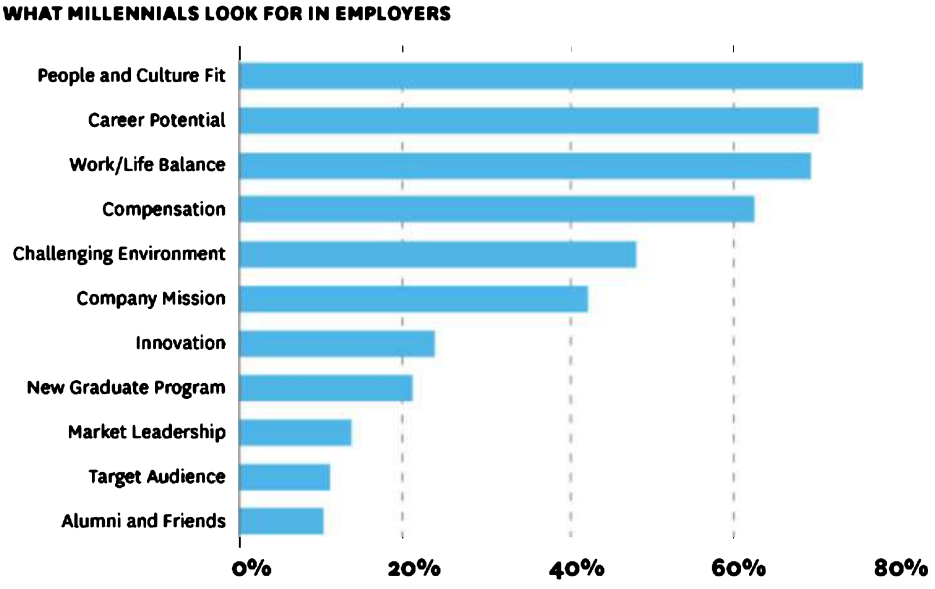


Figure 1: What Millennials look for in employers, HBR

published by Harvard Business Review, which contains answers of 15,000 polled Millennials worldwide. We have found that some assumptions and results are common for Millennials in Serbia, while other are not.

Even if criteria like company mission and market leadership are expected to be on the top of the priorities, people and culture fit and career potential are leading with more than 70%, which is similar to the responses of Serbian Millennials. Both groups of Millennials, in Serbia and worldwide, highly appreciate work-life balance, more than any other generation before.

Respondents in Serbia, 83.2% of them, evaluate compensation, as key criteria, on higher level, than respondents worldwide (about 60%).

Globally, teamwork is ranked fairly high, while among Millennials in Serbia this percentage is much lower. The cause of this probably lies in the education system and the methods used during the years of education, which vary.

6. CONCLUSION

The Millennial generation will represent 50% of the global workforce, by 2020. This generation has many specific characteristic that differentiate it from all the previous generations. This is why organizations find it challenging to create a workplace which is appealing to the Millennial generation. Obradović (2009) also points out that creating a motivating work environment is a great challenge for managers because different types of employees expect different working conditions, depending on the generation belonging.

According to Bannon, Ford and Meltzer (2011) "the challenge for businesses will be to motivate Millennials by playing to their technological strengths, embracing social networking relationships, celebrating their diversity, and helping them balance work and family".

The PwC's NextGen study (2013) suggests that emotional connection drive retention, and emotional connection can be created through providing a work-life balance, engaging work, development, different opportunities, but also through people and teams, and last, but not the least, through competitive pay.

According to this study, employers should create a flexible work culture, build a sense of a community through teamwork and constant feedback, connect with people, embrace the new technologies and social networks, encourage learning and allow faster advancement - in order to attract and retain Millennials.

REFERENCES

Agrawal, S., (2014), *How Companies Can Attract the Best College Talent*, Harvard Business Review

Bannon, S., Ford, K., & Meltzer, L. (2011), *Understanding Millennials in the Workplace*, The CPA Journal, New York State Society of CPAs

Blanchard, M., (2009), *Creating A Motivating Work Environment,* The Ken Blanchard Companies: Office of the Future

DeVaney, S., (2015), *Understanding the Millennial Generation,* Journal of Financial Service Professionals

Esoda, E. J., (2013), *Keep these points in mind when recognizing Millennials in the workplace,* Central Penn Business Journal

INSEAD, (2014), Global Millennial survey

Krupienski, J. (2016), *Millennials and Your Business: This Generation Is Already Making a Seismic Statement,* Business West

Lancaster, L. & Stillman, D., (2010), *The M-Factor: How the Millennial Generation Is Rocking the Workplace,* Harper Business

Ludden, J., (2010), *When Employers Make Room for Work-Life Balance*, NPR

Obradović, V., (2009), *Motivators: What sets project teams in motion?*, Project Managament Association of Serbia - YUPMA, Belgrade, Serbia

Palmer, T., (2015), *Millennial Employees' Role in the Modern Workplace,* Production Machining

Pew Research Center, (2010), *Millennials: Confident. I Connected. Open to Change*

Pew Research Center, (2014), *Millennials in Adulthood*

PricewaterhouseCoopers (PwC), (2008), *Managing the Millennials: HR Survey of Recent Graduates*

PricewaterhouseCoopers (PwC), (2011), *Millennials at work – Reshaping the workplace*

PricewaterhouseCoopers (PwC), (2013), *PwC's NextGen: A global generational study - Evolving talent strategy to match the new workforce reality*

Raines, C., (2002), *Connecting Generations: The Sourcebook - Managing Millennials*

Spano, K., (2015), *Millennials and the workplace: Recruiting the best and brightest,* New Hampshire Business Review
Stokes, B., (2015), *Who are Europe's Millennials?,* Pew Research Center
Wasley, P., (2015), *Understanding Millennial' traits will help you prepare for succession*, Family Business Magazine

SUSTAINABLE BUSINESS DEVELOPMENT 1367

SUSTAINABLE DEVELOPMENT AS AN ALTERNATIVE SOCIETY OF THE FUTURE 1368
Žnidarič Davorin

SUSTAINABLE TECHNOLOGY AND BUSINESS INNOVATION PRINCIPLES – A COMPREHENSIVE APPROACH 1374
Levi Jakšić Maja, Rakićević Jovana, Jovanović Milica

CORPORATE SOCIAL RESPONSIBILITY: PHILANTHROPY, OBLIGATION OR UTILITARIANISM? 1382
Stojanović – Aleksić Vesna, Bošković Aleksandra

THE IMPORTANCE OF ETHICS OF THE BUSINESS ORGANIZATIONS FOR SUSTAINABLE BUSINESS DEVELOPMENT 1389
Erić Ivana

CONSISTENCY OF THE EUROPEAN COMMISSION'S ASSESSMENT OF PROPOSED MERGERS IN AIRLINE SECTOR 1396
Babić Danica, Pavlović Dejan

THE UPRISE OF THE MIDDLE EAST CARRIERS – EMIRATES' PATH TOWARDS SUCCESS 1405
Kuljanin Jovana, Kalić Milica

SUSTAINABLE BUSINESS DEVELOPMENT

SUSTAINABLE DEVELOPMENT AS AN ALTERNATIVE SOCIETY OF THE FUTURE

Davorin Žnidarič
FOV- Kranj, Slovenia
e-mail: davorinznidaric@gmail.com

Abstract: *A quick glance at the past and recent periods of time with accumulated environmental problems in time and space, certainly can't give us any pleasure, that we have developed in the right direction as a society. Many years of materialistic exploitation of the environment and it's natural resources, forces us into a completely different concept of development of the future soceity, with it's practical and negative consequences because of the degradation in space. Rivarly, selfishness, egoism, have to be replaced with cooperation, empathy, harmony and solidarity, in between all segments of time and space. Thus between society and nature, be it living or nonliving or between individuals or society as a whole. Involving the wider society in decision-making and accountability, but the basic prerequisites for a change in attitude towards the environment and nature.*

Keywords: *environmental problems, society,natural resources, cooperation, time and space*

1. INTRODUCTION

The time we live in, has been marked by a period of neo-liberal policits, which was based on materialistic exploitation of the environmanet and it's natural resources, social and societal changes that led to the social stratification of the broadest masses and establishment of the elites and capital. At a time when the idea of Milton Friedman (author of the liberal concept and the leader of the so-called Chicago school) in the countries of South and Central America and transition countries (especially Eastern Europe), and Slovenia, was developing in all its "power" is marked by the loss of the middle class, inequality, wild transition in terms of appropriation of firms by individuals and elites, as well as the exploitation of natural resources beyond all reasonable limits. With the increase of the number of inhabitants, the development of industry and transport, have increased demands for goods which have resulted in enormous exploitation of natural resources. Consequently causing pressures on the environment and loss of natural habitats and biodiversity by reducing the animal and plant species. If we have lost 0,2 to 0,5 species in a natural way in a period of a million years (Rockstroem & others in Plut, 2010), we have lost 30% of biological wealth of the planet from 1970 to 2008 (WWF& Living Planet Report, 2008), which can not be replaced by any kind of material assets. The consequences of such practices in and on the environment have led to changes that may be in the area combined with a common denominator as:

- changes in provincial land use and vegetation
- changes in the composition of the atmosphere
- changes in the composition of natural communities and biodiversity loss

Among the anthropogenic (manmade) effects on biodiversity by Jones (2004 in Plut 2010) we can include the following key factors:

- deforestation, primarily due to agriculture
- the use of mineral fertilizers and protective agents for the control of agricultural ecosystems
- increasing urban and industrial land use, thereby burdening the environment
- increasing pressures on flora and fauna due to the growth in population and habitat loss
- climate change due to fossil fuel use

Environmental and social degradation, increasing social disparities and pressures on nature, force us to seek alternative routes for the existence of the planet. Many of domestic (Plut, Kirn, Luksic, Vintar - Mally) and

foreign experts (Bookchin) are of the opinion that radical social changes are necessary if we want to change, or at least maintain the state in which we currently live in and future generations will live in and at the same time enable more or less a decent life. Currently the only option is given by sustainable development, based on the balance of society, the environment-nature and economy-industry. It is a way, which should replace the neo liberal, materialistic concept, because that in the long run leads to shortage (some parts of the world already) and conflict among civilizations, such as the nature.

2. SUSTAINABLE DEVELOPMENT - BASIC CONCEPTS

The concept of sustainable development today can be traced on different levels and different topics. Munro (1995) suggests that it is reasonable to separate sustainability or sustainability as a concept and a key assessment criterion for development and sustainable development as an achievable goal. And states (Munro, 1995), that sustainable development is "a set of activities that would permanently improve the situation for humanity" or "improving the quality of human life within the supply capacity of ecosystems." Thus conceived definition, (Plut in Plan B, 2007) excludes any "sustained economic growth and sooner or later exceedes the universal ecosystem, biophysical capabilities and limitations." The concept of sustainability (Plut, 2004) is seen as a three-dimensional concept, which integrates environmental, social and economic note, but it is necessary to add another two fields, namely a democratic political decision-making process and society's value system. Mansfield (2009) states that the concept of sustainability must include not only technical, but also ethical and political field power centers, which have a strong influence on the creation and on the other hand, solving environmental problems (Mansfield in Plut, 2004). Plut (2014), sustainable development is seen as the environmental, economic and social responsibility, based on a comprehensive, multi-faceted inter-generational responsibility, which is based on the well-being of humanity in the context of local and global capabilities. Most cited but rather vague, is the definition given by the World Commission for the Environment and Development, or the so-called Brundtland Commission, which by one of the definitions, defines sustainable development as; "development that meets the needs of the present without compromising the capacity of future generations to meet their needs "According to WCED (2015) Sustainable development is a delicate balance between the human need for improved lifestyle and a feeling of well-being on one hand, and preserving natural resources and ecosystems on which we and future generations depend. Sustainable growth and development, therefore, are based not only on economic growth but are designed to lead to social and environmental benefit, based on stability, therefore, in the context of environmental, social and economic constraints. That modern civilization has reached the point where we have already reached the limits of the biosphere, and in some cases we have also already exceeded, which has to be dealt with and the need to consciously abandon the paradigm of sustainable economic growth and the associated burden on the planet, is also pointed out by Kirn (2012). Kos (2016) is of the opinion that economic growth has to be in balance with social and environmental performance. Plut (2004) in the article Planet and Slovenia faces the challenges of globalization and sustainable development and states, that "the economy is environmentally acceptable only if it satisfies the principles, the principles of environmental sustainability (sustainability), based on the ecology."

Environmental and social interpenetration instead of discernment of nature and human activity is also pointed out by Mansfield (2009), who discusses the current development model of modern civilization and the proposed adjustment of the economic sub-system capabilities of a wider planetary ecosystem. Sustainable development, such as integration, interdependence, coexistence of three separate fields of the economy, environment and society are determined by Bell & Morse (2003).According to Omladič (2011), a sustainable model can be defined as the pursuit of the four core objectives of mankind, enabling the satisfying of basic human needs and well-being of humans and all other creatures, achieve a more equal and more comparable level of life of all people within the (local, regional) and outside the regional Community. In the development we must consider biodiversity in terms of maintaining it and minimizing pressures on the environment. The last goal, Omladič (2011) states is that development should not undermine the ability of future generations and to simultaneously provide a similar or better standard of living than it is now. Importance of the sustainability, individual organizations such as the Sustainable Seattle, define as "long-term, cultural, economic and environmental health and vitality", with an emphasis on long-term, "along with the integration of social, financial and environmental prosperity " or "improving the quality of

life, taking into account the capacity of the planet" (World Wide Fund 2016). According to Pearce, Makandi & Barbier (1989) Sustainable development involves the creation of a social and economic system that with growth in real income, will help improve the standard of education, quality health care, thereby improving the quality of life. That the definitions of the concept of sustainable development are almost as many as individuals and professions from which they arise, and thus varying in definitions is pointed out by Seljak (2000).

2.1 Models of sustainable developments

For the optimal choice of a sustainable development, it is necessary to take into account several factors, which include, the geographical characteristics of individual areas, such as location, natural and human potential, which includes investment in society and the individual, the social situation and the development potentials of the area, environmental - ecological conditions or state of the environment in time and space. Among the most important (factors), we can include the degree of awareness of companies and individuals through participation and taking responsibility for the situation and their relationship in the area.
Lukšič (2005) mentions two approaches to the process of achieving the goals of sustainable development:
•top-down approach: in the implementation of the principles of sustainable development, the state plays a major role; (which has been in the current practice proved to be an extremely flawed option, at least in setting policies and their implementation in practice).
•bottom-up approach: there is a decentralization of power at a lower level. Local authorities have an important role in the management of local ecosystems, land use planning, are responsible for the disposal of waste, arranging local transportation, etc. (Their effectiveness and adaptability to existing problems depends on the orientation of a local policy, but in most cases do not follow the social requirements and are often better placed to defend the capital - such as Zasavje). In this case, most of the problems lie on the shoulders of local communities, not however on the shoulders of environmental burdeners, but the price is paid by all, irrespective of the fact that inhabitants and the civil society on important environmental social issues generally have no effect, or the possibility of decision-making. We believe that it is necessary that both concepts are adjusted to the reality in time and space, and connect them with eachother (national and local), so we can ensure coordinated operation and their accordance with the norms and concepts of sustainable development, and in advance, depending on the situation in the area identify certain goals and then on the basis of the given analysis find the optimal options for balancing the developments and solutions in practice.

2.1.1 Designs available to us (by Baker, Lukšič & Bahor) can be divided into four phases/periods:

- **Ideal (ecocentric) model - strong sustainability,**

Is the model, which as a desired stage of development of Slovenia and the regions belongs to the years between 2030 to 2050. The time of the near future and the continuation of the previous phases of development (a very strong sustainability) and related activities. This type of development is both a sequel and upgrade of all models of developmental stages and represents the final stage, which is completely different, with a not-materialistic concept of development of society and thought. Development rests on the foundations of a priority as environmental well-being, a moderate material prosperity for all, within the limits of the environment, it provides social security, and the predominant use of renewable energy sources. At the spatial level, upgrade continues in the direction of bio-regionalism, the dominance of eco-villages and buildings, as well as the actualization of regional and local self-sufficiency.

- **Strong sustainability**

Type of development goes in the direction of balancing economic, social and environmental areas of prosperity based on the principles of environmental ethics. At the same time the model includes market valuation of ecosystem services, which need to be incorporated into the prices of goods and services. Invest profits into new technologies that allow reducing consumption of regional resources to strengthen local and regional economies as well as the reduction of regional disparities. Looking at the policy of realization, this is based on the active participation of the public, as well as the integration of environmental considerations and environmental technologies in sectoral policies through sustainable education and training at all levels.

- **Weak sustainability**

Proponents of this model are of the opinion that economic growth and environmental protection are not mutually exclusive and, therefore, are not completely at odds. They defend the principle that future generations should not reduce the total capital, but the decrease of the natural can be compensated by increasing the created. They advocate for the global market, at the expense of modest initiatives to the local economy. Advanced concept (weak sustainability) has been committed to solving the pollution at the source. Overall, the strategic development documents of Slovenia among this model (weak sustainability), which integrates economic growth with environmental concerns, does not seek to reduce the consumption of natural resources. Therefore, Slovenia is still relying on a policy to improve substantial energy flows with the aim of (quantitative) growth. But from the perspective of a sustainable future society is by no means an acceptable way, especially given the fact that the market only partially takes into account the environmental policy (Lukšič & Bahor, 2006). Weak sustainability (sustainability) after based on the assumption that with a sufficient degree of accumulation of capital and technical developments can compensate for the depletion of natural capital. Implementation of such a policy, or a model (weak sustainability) can be "seen" in the environment as the adoption of urgent environmental measures by polluters, and even then only in case of extreme coercion, as was the case with Zasavja when the maximum polluters (Larafge cement and TET) built the desulphurisation plant only after we entered the EU and thus require policy from the outside. As a positive factor for weak sustainability we could only accept a more environmentally adapted but sustained economic growth to eliminate poverty in the world (Plut, 2014).

- **Pollution control**

Is the lowest level of realization of the greening of development, based on the exploitation of natural resources, exponentially, market guided growth, and the thesis that nature has practical value. At the spatial level tends to globalization and the exploitation of the less developed areas of the world that have looser laws in terms of environmental and social standards. Solutions of this approach are in the construction of treatment plants, thus resolving the consequences, not in terms of eliminating the causes. While maintaining or realizing policies that support capital-intensive technology. Each of the above models has its own characteristics, which makes the top-down (ecocentric model - the control of pollution) follow in the direction of greater emphasis on nature and the environment, the exploitation of natural resources, and the different spatial levels and policy realization (Baker, 2006, Lukšič & Bahor, 2006). What model and to what extent, should be selected according to environmental, social and socio - economic characteristics, which are based on the development and the level of the observed region.If the individual models are time defined according to the desired sustainable development and the current situation, the stages follow: the stage of very weak sustainability, and pollution would have long since surpassed, at least with regard to the time period (the period between 1985 to 2004), weak sustainability should have ended in the previous year (2005-2015), the most pronounced stage is still in store for us in the following years. Strong Sustainability (2016-2030) as well as a very strong one (2030 and 2050) from this year until the middle of this millenniu. Featured models may only offer support and guidance, so we can in practice choose a way of implementation of individual activities in the three supporting pillars of sustainable development, which without the active involvement of the wider community, and especially their participation will not be able to successfully perform in a way, that will satisfy all three basic segments, society, environment and economy. Especially given the fact, as the sustainable development of society and its engagement in the decision-making gives a special role and importance.

In short term the company is treated in a completely different way than a before generally valid concept, based on more vertical-hierarchical decision-making process, and is inclined to the horizontal, which includes the increasing role of the civil society. In social decision making, is therefore an increase of active roles of individuals and communities, thereby gaining an important role in decision-making on important issues, not only on the environment but also in the political field. This increases participation on the one hand and responsibility on the other hand, of the decision-making system. As stated by Lukšič (2005) active society that are "understood as those members of society who are able and willing to let their actions be guided by the rules of collective-racional and responsible self commitment", thus taking over the work and roles that were previously the exclusive domain of state institutions. The same author states, (Lukšič) that only in this way (Participation of) "individuals related to social connections and associations and movements, and environmentally aware public, thus shaping what is common best."

3. THE PILLARS OF SUSTAINABLE DEVELOPMENT

Despite the different definitions of sustainable development, the supporting pillars of the above mentioned developments are combined in the following denominators:

- stabilization of the world population,
- URE and use of OVE,
- reuse - recycling of materials,
- materially moderation installed consumerism,
- reduction of material and energy flows,
- the balance between economics, social affairs and the environment, and
- orientation to development, social, environmental, solidarity and ethics (Plan B, 2010).

If we want to survive on a planet that is spatially and materially limited, it is necessary to radically change some consumer habits. First, on a personal hereinafter even at the social level. Energy consumption, consumption goods, especially a change in thinking and attitude towards the environment must present a hierarchical way of relating to nature and the environment, which was based on the dominance of -the power of the individual- EGO, change the way of the general equality and empathy, or ECO-but among all stakeholders live and inanimate nature.

4. CONCLUSION

After Mintz (1992) we will achieve sustainable development when we can introduce participatory democracy, which will not be dominated by the interests acquired. So in the time when intergenerational solidarity and equality irrespective of skin color status dominate, based on respect for diversity, raising global awareness of environmental and social standards, which will be the same for all living beings on the planet. Planet, which according to Elliot (2003) survives only if the economy and technological activities remain sustainable within the carrying capacity of the environment and its natural resources. The society of the future will have to be based on a totally different basis, than the society of the past, we are witnessing today. The values of solidarity, cooperation, coexistence, understanding will have to be predominant in relation to society, the environment and especially nature. Conservation of fauna and flora, healthy and clean environment, not only desire, but a basic right that should not be just an empty word written on a piece of paper.

Sustainable development paradigm of the future of the society, which is based on the balance of social, environmental and economic indicators and areas, does not have an alternative if we are to survive on this planet.

REFERENCES

Baker, S. (2006). Sustainable Development, London & New York. GB, USA, Routledge

Bookchkin, M. (1982). Ecology of freedom, Palo Alto , London & New York, Routladge

Elliot, A. (1994). An Introduction to Suistainable Development, London, Routladge

Kirn, A. (2012). Družbenoekološki obrat ali propad, Ljubljana, Fakulteta za družbene vede

Kos, D. (2002). Praktična sociologija za načrtovalce in urejevalce prostora. Ljubljana: Fakulteta za družbene vede, zbirka Teorija in praksa, 168. (ISBN 961-235092-2)

Lukšič, A. (2005). Modificiranje in odpiranje okoljskih političnih aren; *Časopis za kritiko znanosti letnik* 33, številka 219, Ljubljana, FDV

Lukšič, A. & Bahor, M. (2006). Trajnostni razvoj v luči Lizbonske strategije in njene revizije. V: Slovenija v evropski luči znanja in razvoja. Ljubljana, Fakulteta za družbene vede

Mansfield, J. (2009). Sustainable refurbishment: policy direction and support in the UK. Nottingham, Nottingham Trent University

Mintz, J. (1992). Environmental Laws and Sustainability: An Introduction; Retrieved from; www.mdpi.com/2071-1050/3/3/531/pdf

Munro, D. (1995). Sustainability: Rhetoric or Reality, A suistainable World, Sacramento-Claremont

Omladič, L. (2014). Slovenska okoljska politika v luči globalne razvojne dileme, Retrieved from; http://www.umanotera.org/wp-content/uploads/2014/10/zbornik-plan-b-2.0.pdf

Plan B. (2010). Retrieved from: http://www.umanotera.org/wp-content/uploads/2014/10/zbornik-plan-b-2.0.pdf

Pearc, Makandi & Barbier (1989). Green economics. Envoronmental values 1.Retrieved from: http://www.environmentandsociety.org/node/5454

Plut, D. (2004). Zeleni Planet?; prebivalstvo, energija in okolje v 21. stoletju, Radovljica, Didakta

Plut, D. (1995). Brez izhoda? Ljubljana, DZS

Plut, D. (2010). Geografija sonaravnega razvoja, Ljubljana, Znanstvena založba filozofske fakultete

Seljak, J. (2000). Plan B.Retrieved from: http://www.umanotera.org/wpcontent/uploads/2014/10/zbornik-plan-b-2.0.pdf

WWF. (2008). Living Planetreport, Retrieved from: http://wwf.panda.org/about_our_earth/all_publications/living_planet_report/living_planet_report_timeline/lpr_2008/

WWF. (2016). For nature 1991, Retrived from: https://en.wikipedia.org/wiki/World_Wide_Fund_for_Nature

SUSTAINABLE TECHNOLOGY AND BUSINESS INNOVATION PRINCIPLES – A COMPREHENSIVE APPROACH

Maja Levi Jakšić[1], Jovana Rakićević*[1], Milica Jovanović[1]
[1]Faculty of organizational sciences, University of Belgrade
*Corresponding author, e-mail: jovana.rakicevic@fon.bg.ac.rs

Abstract: *Society is looking for solutions leading to sustainable development (SD). The paper focuses on sustainable innovation in technology and business as cornerstone for developing sustainable economy and society. In this context, the paper aims to identify the key relationships and develop the key principles of sustainable technology and business innovation by integrating the general SD dimensions, sustainable business goals and technology and business innovation principles. This paper uses a systematic literature and practice review approach to formalize a categorization of technology and business innovations to deliver sustainability. The research results in the form of a comprehensive framework and contributes to the theoretical background for creating more sustainable business and technology solutions in practice.*

Keywords*: Sustainable development (SD), SD principles, sustainable technology, sustainable business model, sustainable innovation, sustainable economy*

1. INTRODUCTION

Sustainable technology and business development is viewed as the central pillar of sustainable development (SD). Relevance of the subject is based on the necessity for firms to reconcile sustainability aspects, simultaneously fulfilling all the stakeholders' needs while reaching profitability and respecting the diversified demands of social goals fulfillment (Adams, 2014; Epstein & Roy, 2001, Levi Jaksic, 2015). Traditional technology and business innovation models need rethinking (Ricart, 2014; Chesbrough, 2003, 2014; Levi Jaksic, 2006, 2015).

SD is most commonly defined as "the development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland Report, 1987) and since then it has been developing and countries, organizations, institutions worldwide have committed towards the goals incorporating shared principles, objectives, instruments. In the past decades there is evidence of a rising interest of researchers and practitioners in sustainable technology and business innovations, especially dealing with technology innovation embedded in a business environment that contribute to developing sustainable economies and societies. (Boons & Ludeke-Freund, 2013; Bocken et al., 2014; Raney, 2006). The challenge for SD is in transforming goals, objectives and principles into concrete actions, behaviors and attitudes at all levels of the economy and society.

Radical technological breakthroughs and innovation in the light of social, economic and ecological impacts and goals, call urgently for new business and technology models and solutions. In this paper the key dimensions of sustainable development (SD) are transformed into sustainable business goals, and further extended to technology and business innovation principles related to these goals.

Sustainable business development rests upon sustainable technology and innovation, and managing technological change directly influences sustainable competitiveness of business operations (Popa, 2014; Rainey, 2006; Levi Jaksic, 2012; Porter, 1985; Chesbrough, 2006; Levi Jakšić, 2006, 2007, 2012, 2015; McIntyre et al., 2013) and more specifically "it is indeed at the strategic level that sustainable development can fully uncover its value creation potential for a company" (Sempels & Hoffman, 2013, p. 3). The relevant literature and practice review shows that in some cases, sustainable solutions in industrial practice appear to be ahead of academia in exploring and developing novel business models (Bocken et al., 2014; Chesbourough, 2014; Moore, 2014).

The remainder of the paper is organized in the following manner: Section 2 presents literature review and basic concepts elaborating the main objectives and hypothesis of a comprehensive approach towards sustainable technology and business innovation. Section 3 elaborates on the relations between SD dimensions, sustainable business goals and sustainable technology and business innovation by developing a set of related matrices. Section 4 deals with concluding remarks, indicates limitations as well as elements of future research. At the end the References are presented.

2. THEORETICAL BACKGROUND – BASIC CONCEPTS OF TECHNOLOGY AND BUSINESS INNOVATION MODELS

The aim of this paper is: 1. to investigate the relationships between the SD dimensions, sustainable business goals and Sustainable Technology and Business Innovation principles and models, and 2. to develop a comprehensive framework for a systematic approach towards business sustainability leading to more direct firm strategies for capturing the sustainability synergetic effects. The problem is approached through developing a model of related matrices establishing relationships between SD goals focusing sustainable economy routes and dimensions, sustainable business goals and technology and business model innovations. More precisely, the paper deals with the overall strategic perspectives of business, technology and innovation management for sustainable development. The research is based on perspectives of conceptual reflection in literature and is based on methods of analysis and synthesis, of interpretation and relevant comparisons.

Technology and business innovation drive the economy towards achieving the sustainable development goals. The technology we use in performing business operations affects the environment, society and economy, and in this way technology and business enterprises are generators of potential damage and unwanted effects to global environment, while simultaneously, they are the key solutions to these problems by developing sustainable technology for sustainable businesses. Hence, the emphasis is on technology and business innovation, where sustainable technology and business strategy is approached through sustainable business, technology and innovation principles and models (Adams, 2014; Mendelson, 2014; Hall et al., 2010). "If the business model cannot align economic, environmental and social issues, the only credible solution is to change it....the business model should be innovated by integrating sustainability in order to build or keep a competitive advantage in an ever changing economy" (Sempels & Hoffman, 2013).
In the Society and Environment Pull Business Model (Levi Jaksic, 2015), the external and internal factors of the firm environment are interrelated in a virtuous cycle model with social and environmental objectives affecting sustainable business strategy, leading to business and technology innovation, further affecting the processes of creating and delivering value in the form of goods and services which are by market reaching customers and are affecting consumption, further influencing the fulfillment of the initial social and environmental objectives.

Review of relevant literature on the definitions of business model, it is evident that the concepts of technology and business innovation are closely linked. A business model is a conceptual tool to help understand how a firm does business and can be used for analysis, comparison and performance assessment, management, communication and innovation (Osterwalder & Pigneur, 2005). Also, a business model is used as a plan which specifies how a new venture can become profitable (Boons & Ludeke-Freund, 2013) and it describes "how companies create and deliver value to their customers and how they get rewarded for doing that" (Mendelson, 2014; Callon et al., 2007).

The relevance of business model innovation in delivering greater social and environmental sustainability is increasingly recognized and all the relevant components of the Business Model are to be included (Bocken et al., 2014). It means changing the ways you do business and shifting the focus from developing individual technology towards creating new systems, with a broader perspective of stakeholders necessitating a value network perspective for innovating and transforming the business model (Bocken et al., 2014). In the relevant literature, business model consists of different blocks: value proposition, value architecture and economic equation (Sempels & Hoffman, 2013), or value proposition, supply chain, customer interface, financial model (Boons & Ludeke-Freund, 2013). In this paper a business model is defined by three elements: value proposition, value creation, and delivery and value capture.

In this paper, technology innovation is approached by adopting the OECD definition (1995): "Technological product and process (TPP) innovations comprise implemented technologically new products and processes and significant technological improvements in products and processes. A TPP innovation has been implemented if it has been introduced on the market (product innovation) or used within a production process (process innovation)". In this definition 'product' comprises not only manufacturing output, but also services (Cetindamar et al., 2009).

An answer to the dilemmas concerning the relations between business model and technology innovation, especially the dilemma of which is more significant "the hen or the egg", could be found in the brief statement by Chesbrough (2014) "Innovate the business model, not just the technology" further explicated as "a better business model often beats a better technology". In this article it is argued that sustainable technology innovation is inseparable from sustainable business, as represented in the Sustainable Technology and Business Innovation Push - Pull Model (Levi Jaksic, 2015).

3. RESEARCH FINDINGS

Business models have received attention in literature and industry and it is increasingly suggested that business model innovation is the key to business success (Chesbrough, 2006, Boons & Ludeke-Freund, 2013, Bocken et al., 2014). The main question and concern is how to encourage corporate innovation that significantly changes the way companies operate to ensure greater sustainability. "Sustainable business models with a focus on technological innovation are market devices that overcome internal and external barriers of marketing clean technologies: of significance is the business models ability to create a fit between technology characteristics and (new) commercialization approaches that both can succeed on given markets" (Boons & Ludeke-Freund, 2013).

3.1. Sustainability goals in innovative company practices

Innovative firm performance measures (Epstein, 2001; BRW, 2015; FastCompany, 2015; FastCompany, 2016; FORBES Innovative Companies, 2016), the main indicators used for innovativeness and the results of the analysis identify sustainability goals as the main driving force for innovation.

The results of a detailed analysis of innovative performance of companies from the *FastCompany* list presented in Table 1. The table indicates the rising relevance of sustainable goals embedded in technology and business innovation. The list taken into consideration includes analysis of 100 companies, 50 most innovative companies in 2015, and 50 in 2016. As it is shown in Table 1, 73.20% of companies have at least one component sustainable (technology and/or business model).

Table 1: Share of each SB&T model combination on the selected sample

		Business model		
		Existing	New	Sustainable
Technology	Existing	0%	7.22%	**17.53%**
	New	5.15%	14.43%	**17.53%**
	Sustainable	**13.40%**	**4.12%**	**20.62%**

These companies are considered further in order to examine which component of sustainability they focus on the most (environmental, economic, or social). Table 2 refers to the analysis of sustainability aspects of technology, examining existing, new or sustainable business model. It is evident that in all these cases, the main focus is on economic and social aspect of sustainable technology, but is important to emphasize that all the three aspects of sustainable technology are present.

Table 2: Analysis of presence of sustainability aspects in technology

	Sustainable technology		
	Environment	Economic	Social
Existing business model	38.46%	92.31%	69.23%
New business model	25.00%	100.00%	100.00%
Sustainable business model	45%	80%	85%

Table 3 refers to the analysis of sustainability aspects of the business model, testing three technology cases (existing, new or sustainable). Again, the results indicate that although companies focus mostly on economic and social aspects of the business model, in all the cases ecological aspect is detected.

Table 3: Analysis of presence of sustainability aspects in business model

	Sustainable business model		
	Environment	Economic	Social
Existing technology	41.18%	88.24%	88.24%
New technology	35.29%	88.24%	100.00%
Sustainable technology	30%	88.24%	100.00%

3.2. The related matrices of SD dimensions, sustainable business goals and sustainable technology and business innovation

The complex goals of sustainable development (SD) are based on a set of social, economic and environmental equations, noted as the Triple Integrated Equation (TIE). Within this framework the principles of sustainable business and technology innovation are developed involving 'a holistic view of the business environment taking into account social, economic and environmental considerations as well as the more conventional concerns of customers, markets, and competition" (Rainey, 2006). The crucial goals of SD are in relevant literature examined as specific "routes" or "principles" leading to sustainable economy and society.

The "route to sustainable economy" (Jackson, 2009) postulates the characteristics of a sustainable economic system. "Hannover" principles were developed for the purpose to articulate the basis for integrating business management with the realities of humanity and nature (Raney, 2006) comprising the following: insist on the rights of humanity and nature to coexist; recognize interdependence; respect relationships between spirit and matter; accept responsibility for the consequences of design; create safe objects of long term value; eliminate the concept of waste; rely on natural energy flows; understand the limitations of design; seek constant improvements by sharing of knowledge.

Based on relevant literature and practice review we have identified the following dimensions of sustainable economy:

- Circular economy, defined by the rule of transforming 'waste' into a productive resource and transformation from linear to circular flows in the economy, cited as the "new industrial system that replaces 'end/of life' concept by restoration and regeneration by intention and design" (Sempels & Hoffman, 2013). In this manner each product at the end of its life time or each waste is likely to become a resource for a new cycle of production.
- Substituting with renewables, alternatives and natural processes in order to preserve the natural environment and reduce the exploitation of scarce natural resources. It is defined as reducing environmental impacts and increasing business resilience by addressing resource constraints associated with non-renewable resources.
- Minimizing consumption is related to the overall change of attitudes and behaviour of all the actors in the economy and society, based on a new philosophy of economic and social relations. It is also defined as solutions actively seeking to encourage sufficiency based business models reframing the value proposition to better address the broader range of stakeholders (Bocken et al., 2014).
- Establishing S-E benefit/cost relationship, related to maximizing S-E benefits and minimizing S-E costs based on rethinking and reconsideration at a global scale the principles and models that have been developed in the traditional approaches and applied in practice. Field and Field (2006) argue that the social cost components include the external costs. It is a cost that appears for society and the environment caused by the activity of an enterprise. "Social entrepreneurship provides a social value from its business activities which has an impact on society or the environment" (Bagus & Manzilati, 2014). The rethinking of the business models includes efforts to appraise the costs and revenues in a broad social and environmental perspective, and some solutions introduce Costs and Benefits for Society and the Environment in the sustainable business models (Sempels & Hoffmann, 2013).
- Positive and motivating work experiences enhancing human creativity and skills is emphasizing the satisfaction of working population as the driving force of creativity and innovation.
- Collaboration and sharing rather than aggressive competition is a quest for more integration and cooperative solutions in the activities of the agents in the economic system. It means strategic orientation towards Blue Ocean strategy (Sempels & Hoffmann, 2013).
- Factor 4 is defined as a strategy of halving resource use and doubling wealth indicating integration of the triple equation goals (Bardy & Massaro, 2013).

In Table 4 the dimensions of sustainable economy are related to Sustainable Business Goals (SBG) and presented in a matrix relationship model. It is noted that the elements of the matrix do not represent an exhaustive list; it is open for new considerations.

The SBG are listed as follows:

- Maximize material and energy efficiency, based on material productivity resource efficiency and waste reduction. It means doing more with fewer resources and generating less waste, emissions and pollution. It is in line with the traditional cost reduction goals of the manufacturing sector designated as 'lean manufacturing' seeking to minimise waste in production processes;
- Create value from waste is the concept by which waste is eliminated by turning waste streams into useful and valuable input to other production and making better use of underutilized capacity;

- Zero waste & emissions goal sets high business operations quality management standards and procedures;
- Delivery of functionality rather than product ownership is a strategic goal to provide services that satisfy users' needs without having to own physical products (Bocken et al., 2014);
- Stakeholder satisfaction is a goal that identifies the interests of firm's various stakeholders and articulates the specific goals and strategy to satisfying these goals. The company responds to all stakeholders' needs: those of consumers, employees, suppliers, local community and other stakeholders (Adams, 2014, Epstein, 2011);
- Reduce costs as the general goal reducing all costs is specified also in relation to identifying all the costs in the long-term perspective of business operations affecting the society and the environment, including all the costs: direct, indirect, hidden, external and publicly imposed (Rainey, 2006).

Table 4: Matrix relationship between Sustainable Economy Dimensions (SED) and Sustainable Business Goals (SBG)

SBG → / SED ↓	Max. material and energy efficiency	Create value from waste	Zero waste & emissions	Deliver functionality rather than product ownership	Stakeholder satisfaction	Reduce costs
Circular economy		x			x	x
Substitute with renewables	x		x		x	x
Minimize consumption				x	x	
Maximize social and env. benefit	x	x	x		x	
Positive work experiences enhancing creativity & innovation					x	
Collaboration and sharing			x	x	x	
Factor 4	x	x	x			x

In Table 5 the matrix relations between Sustainable Business Goals (SBG) and Sustainable Technology and Business Innovation (ST&BI) principles are established and an open list of the ST&BI principles is listed as follows:

- Open, agile T&B innovation platforms, open models of technology and business in literature often cited as frugal, lean, sustainable, eco innovation and business models. Open innovation models (Chesbrough, 2003, 2006, 2014) integrate a significant number of players across multiple roles in the innovation process expanding beyond the limits of a single organization. Open innovation is a process that makes more effective use of internal and external knowledge in every organization (Chesbrough, 2014). The platform model is an open business and innovation model and considered as the most valuable kind of business model as it can inspire and motivate customers and developers and others to join the platform (Mendelson, 2014). Open innovation is an approach that seeks the systematic adoption of partnerships in the innovation process rather than resorting to internal R&D structures as in the classic model of innovation (Caetano & Amaral, 2011; Chesbrough & Appleyard, 2007).
- Use-oriented Product-Service Systems are based on the transition from products to use- oriented services which are aimed to redefine the relation with 'tangible' goods, by making them available without transfer of ownership with numerous examples and possibilities: hiring, leasing, pooling, shared consumption. It is the transition from ownership to usership (Sempels and Hoffman, 2013), often cited as “servicification, service transition, product-service systems (PSS), Integrated product service engineering” (Reim et al., 2015).
- Reuse, and recycle, also referred to as re-manufacture, up-cycle or down-cycle means reuse of non-renewable materials including fossil fuels, which means that waste and emissions are either avoided or up-cycled. Up-cycling (Bardy & Massaro, 2013) denotes up-cycling as a kind of recycling that produces materials of at least equal quality while down-cycling converting materials and products into new raw materials of lesser quality
- Eco-efficiency and eco-design in a broad manner, for companies means applying the principle of “doing more with fewer resources” and it applies to both products and services. It comprises “reconsideration

of the design of a product, a service or a process in order to decrease its environmental impact" (Sempels & Hoffman, 2013). Eco-design principles are based on the whole life-cycle approach and comprise considerations on the functionality of the product to improve usability and use efficiency, reduce the material and energy intensity and minimise the use of non-renewable resources, minimize toxic components, introduce durability, easy maintenance (Sempels & Hoffman, 2013).

- Value constellation platforms are related to reframing the company activity considering the stakeholders in the value constellation instead of the value chain alone (Sempels & Hoffman, 2013).
- Decouple product from revenue, i.e. decouple revenue generation from raw materials and energy consumption based on the approach 'guarantee of result' instead of the sale of the means to reach that result, which entails the transition from product to result based integrated solutions (Sempels & Hoffman, 2013).

Table 5: Matrix relations between SBG and ST&BI principles

ST&BI principles → / **SBG ↓**	Open, agile T&B innovation (platforms)	Cradle-to-cradle	Use-oriented Product-Service Systems	Reuse, Recycle	Eco-efficiency Eco-design	Value constellation platforms	Decouple product from revenue
Max. material and energy efficiency	x			x	x	x	x
Create value from waste		x		x	x	x	x
Zero waste and emissions				x	x		
Delivery of functionality rather than product ownership	x		x			x	x
Stakeholder satisfaction	x	x	x			x	x
Reduce costs	x			x	x		

In Table 6 the matrix relations between ST&BI principles and Technology and Business Innovation Models are presented. Technology Innovation Model is defined by the innovation of products and innovation of process, while the business innovation model is represented by the innovation of the basic business model components: value proposition, value creation and delivery, and value capturing. The assertion is that with careful business model redesign and sustainable technology innovation it is possible for mainstream businesses to readily integrate sustainability into their business and for new start-ups to design and pursue sustainable business from the outset (Bocken et al., 2014).

Table 6: Matrix relations between ST&BI principles and Technology and Business (T & B) Models

T & B Model →	Technology innovation		Business Model Innovation		
ST&BI principles ↓	Product	Process	Value Propos	Value creation and delivery	Value Capture
Open T&B innovation (platforms)	x	x	x	x	x
Cradle-to-cradle	x	x			
Use-oriented Product-Service Systems			x	x	x
Reuse, Recycle	x	x			
Eco-efficiency Eco-design	x	x			
Value constellation platforms			x	x	x
Decouple Product from Revenue			x	x	x

4. CONCLUSION

As result of the review of the literature and analysis of main concepts introduced in this paper, we come to the conclusion that the concepts of sustainable innovation and sustainable business are converging. It is difficult to draw a line as innovation is understood as commercialization of invention (idea), referring to its market introduction and transfer. Focus on technology and innovation for economic growth and socio-economic development puts stress on technology innovation for achieving sustainable socio-economic development. "Research and experimental development (R&D), when appropriately valorised, lead to technological innovation in the form of new products and processes, which contribute to growth, competitiveness and job creation, and which produce other societal benefits" (Delanghe & Muldur, 2014). Relevant practice review shows that sustainability benefits are achieved often only through combining several approaches, e.g. car sharing without an efficiency focus (e.g. fuel efficiency as a new technology) is unlikely to enhance sustainability since the vast majority of its environmental impacts are in the use phase, not in the manufacturing of the machine (Bocken et al., 2014). Synergy effects are present by combining sustainability efforts at both technology and business innovation.

It is also ascertained that not all the technological solutions are in line with SD goals. The necessity to develop sustainable technological innovation and sustainable business models based on the Triple Integrated Equation involves a change and rethinking of our traditional technology and innovation models. The "idea to idea", "cradle-to-cradle" and complete "life cycle assessment- LCA" concepts and approaches (Sempels & Hoffmann, 2013) introduced in the early phases of research and development and innovation processes, lead to sustainable business solutions in the complete life cycle perspective - idea, innovation, market, exploitation, end of life, new ideas for the next innovation cycle. The solutions emerging from practice indicate new principles with an integrated aim of sustainability and embedded in both business and technological domains.

REFERENCES

Adams, C. A. (2014). Sustainability and the Company of the Future, In *Reinventing the Company in the Digital Age. Open mind, BBVA,* 411-430.

Bagus, A. & Manzilati, A. (2014). Social Entrepreneurship and Socio-entrepreneurship: a Study with Economic and Social Perspective. *Procedia - Social and Behavioral Sciences*, *115*, 12 – 18.

Bardy, R. & Massaro, M. (2013). Eco-social business in developing countries: the case for sustainable use of resources in unstable environments. In *McIntyre, J. R., Ivanaj, S., Ivanaj, V. (eds.) Strategies for Sustainable Technologies and Innovations,* Edward Elgar, 139-168.

Bocken, N.M.P., Short, S.W., Rana, P., Evans, S. (2014). A literature practice review to develop sustainable business model archetypes. *Journal of Cleaner Production,* 65, 42-56

Boons, F. & Ludeke-Freund, F. (2013). Business models for sustainable innovation: the state of the art and steps towards a research agenda. *Journal of Cleaner Production*, 45, 9-19.

Brundtland Report. (1987). *Our Common Future: Report of the 1987 World Commission on Environment and Development.* Oxford, Oxford University Press

BRW. (2015). *BRW list of 50 most innovative companies*. Retrieved from: http://www.brw.com.au/lists/50-most-innovative-companies/2015/

Caetano, M. & Amaral, D. (2011). Roadmapping for technology push and partnership: A contribution for open innovation environments. *Technovation, 31*, 320-335.

Callon, M., Millo, Y. & Muniesa, F. (2007). *Market devices*, Oxford: Blackwell.

Cetindamar, D., Phaal, R. & Probert, D. (2009). Understanding technology management as a dynamic capability: a framework for technology management activities. *Technovation, 29*, 237-246.

Chesbrough, H. (2003). *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Cambridge, MA: Harvard Business School Press.

Chesbrough, H. (2006). *Open Business Models.* Cambridge, MA: Harvard Business School Press.

Chesbrough, H. (2014). Open Innovation: Striving for Innovation Success in the 21st Century, in Reinventing the Company in the Digital Age. *Open mind, BBVA*, 395-410.

Chesbrough, H. & Appleyard, M. (2007). Open Innovation and Strategy. *California Management Review, 50 (1)*, 57-76.

Delanghe, H. & Muldur, U. (2014). Research and experimental development (R&D) and technological innovation policy. In *Durlauf, S. N. & Blume, L.E. (eds.), The New Palgrave Dictionary of Economics, Online Edition.*

Epstein, M. J. & Roy, M. (2001). Sustainability in Action: Identifying and Measuring the Key Performance Drivers. *Long Range Planning 34,* 584-604.

Fast Company (2015). *Fast Company* 50 most innovative companies 2015. Retrieved from: http://www.fastcompany.com/section/most-innovative-companies-2015

Fast Company (2016). *Fast Company* 50 most innovative companies 2016. Retrieved from: http://www.fastcompany.com/most-innovative-companies

Field, B. C. & Field, M. K. (2006). *Environmental Economics: An Introduction.* New York: McGraw Hill/Irwin.
FORBES Innovative companies (2016). *FORBES list of 100 most innovative companies*. Retrieved from: http://www.forbes.com/innovative-companies/
Hall, J. K., Daneke, G. A. & Lenox, M. J. (2010). Sustainable Development and Entrepreneurship: Past Contributions and Future Directions. *Journal of Business Venturing, 25*, 439-448.
Jackson, T. (2009). *Prosperity without growth: Economics for a Finite Planet*. Earthscan, London.
Levi Jakšić, M. (2015). Sustainable Innovation of Technology and Business Models: Steps Toward Rethinking Technology and Business Strategy. Proceedings ASECU, *Openness, Innovation, Efficiency and Democratization*, Cracow University of Economics, 282-293.
Levi Jakšić, M. (2006). The New paradigm of Technology and Innovation Management. *Management, 43*, 28-38.
Levi Jakšić, M. (2007). Technology Innovation Management for Sustainable Business Development. In *B. Rakita, S. Lovreta, M. Petković (eds.), Proceedings of International Conference: Contemporary Challenges of Theory and Practice in Economics,* Ekonomski fakultet, Beograd, 155-167.
Levi Jakšić, M. (2012). Innovation Entrepreneurship for Sustainable Development. In *Tipurić, D. & Dabić, M. (eds). Management, Governance and Entrepreneurship – New Perspectives and Challenges,* London: Access Press, 487-508.
McIntyre, J. R., Ivanaj, S., & Ivanaj, V. (2013). Introduction: Foundational considerations in balancing innovatory processes and sustainable development practices in comparative light. In *McIntyre, J. R., Ivanaj, S., and Ivanaj, V. (eds.) Strategies for Sustainable Technologies and Innovations*, Edward Elgar, 21 – 50.
Mendelson, H. (2014). Business Models, Information Technology and the Company of the Future. *In Reinventing the Company in the Digital Age. Open mind, BBVA, 2014, 63-83.*
Moore, G. (2014). The Nature of the Firm – 75 Years Later. *In Reinventing the Company in the Digital Age, Open mind, BBVA, 2014, 51-61.*
Osterwalder, A. & Pigneur, Y. (2005). *Clarifying business models: origins, present and future of the concept.* Commun, AIS 15.
Popa, H. L. (2014), Integrative innovation as core determinant for sustainable progress. *Procedia – Social and Behavioral Sciences, 124*, 460 – 467.
Porter, M. (1985). *Competitive Advantage: Creating and Sustaining Superior performance*. New York: Free Press
Rainey, D. (2006). *Sustainable Business Development*. Cambridge: Cambridge University Press.
Reim, W., Parida, V. & Otqvist, D. (2015). Product-Service (PSS) business models and tactics – a systematic literature review. *Journal of Cleaner Production, 97*, 61-75.
Ricart, J. (2014). Business Models for the Companies of the Future. In *Reinventing the Company in the Digital Age, Open mind, BBVA, 2014,* pp. 134-146.
Sempels, C. & Hoffman, J. (2013). *Sustainable Innovation Strategy - creating value in a world of finite resources*. London: Palgrave Macmillan.

CORPORATE SOCIAL RESPONSIBILITY: PHILANTHROPY, OBLIGATION OR UTILITARIANISM?

Vesna Stojanović-Aleksić[1], Aleksandra Bošković*[2],
[1]PhD, Associate professor, Faculty of Economics, University of Kragujevac
[2]MSc, Assistant, Faculty of Economics, University of Kragujevac
*Corresponding author, e-mail: aboskovic@kg.ac.rs

Abstract: *This paper examines the basic motives for the implementation of CSR, with a special emphasis on the relationship between motives and the level of engagement in this area. The aim is to explore the interdependence between the various motives and the level of development of specific CSR aspects in the context of its internal and external dimensions. Our findings indicate that CSR in general, and especially internal CSR are more developed when management is primarily motivated by ethical factors, while certain aspects of external CSR are on a higher level in companies whose management highlights strengthening brand and image as the most important motivators. Also, CSR is lower when adopted standards are the main motivators. The contribution of the paper is reflected in the different perspective of problem area, and in the discovery of new insights, which are the basis for future research, but also useful information for management.*

Keywords*: corporate social responsibility, motives, sustainable business, philanthropy, obligation, utilitarianism*

1. INTRODUCTION

Are the motives for corporate social responsibility (CSR) truly philanthropic, or is it just a cover for the achievement of some other, primarily financial or market objectives? Devinney (2009) believes that an enterprise cannot be truly socially responsible, even in the narrowest sense and that the concept of CSR is an oxymoron, just because corporations must balance between the different interests, which are, by their nature, conflicting, and it is naive to believe that their activities are designed according to the requirements of society. Companies actually manipulates social, in order to achieve their own goals. The author presents a rather extreme position, believing that paradigm *do-well-by-doing-good* reflects an unrealistic goal, a noble idea, which is unfeasible in practice.

Contradictory situations, in which the motives of CSR come into question, often occur in practice. The behavior of some well-known multinational corporations, in countries where the law does not sufficiently protect employees, consumers and the environment, is the subject of a negative public criticism. On the one hand, companies state that social responsibility is a key set of values, which they aspire to. On the other hand, they implement activities that are legal in underdeveloped parts of the world, but significantly deviate from the generally accepted code of ethics, as for example: difficult working conditions, inadequate reward system, non-implementation of environmental standards and so on. Likewise, many companies hire graduates as volunteers, thus emphasizing providing opportunities for learning and gaining experience to young people. However, the question remains whether this is the right motive, or the motive is the reduction of labor costs. It is very difficult to give a precise answer on these questions of ethical nature.

There have been made significant research efforts in the area of corporate social responsibility (European Commision, 2011; Devinney, 2009; Aguilera et al., 2007; Porter & Krammer, 2006; Kotter & Lee, 2005; Garriga & Mele, 2004; Carroll, 1999; Committee for Economic Development, 1971; Freeman, 1984; Davis, 1967; Bowen, 1953), but there are still doubts regarding the real motives and goals of these activities (Dare, 2016; Petrenko, 2016; Aguilera et al., 2006; Munilla & Miles, 2005;), as well as their effects on business performance (Surroca et al., 2010; Margolis et al., 2007; McWilliams & Siegel, 2000), but also on the environment and society. Therefore, it is necessary to further investigate the field of CSR of business organization. Particularly relevant issue relates to the underlying factors that motivate management to take initiatives in this area, since it affects the course of action and the level of CSR. Bearing in mind the lack of evidence of this interdependence in the previous research, the work is driven by the desire to overcome the

perceived gap, as well as to emphasize a different perspective on CSR, taking into account the motives that drive this activity, which is the main research subject.

According to determined subject, the basic aim of the research is to determine the extent to which differences in the level of CSR development occur as a result of differences in terms of the key CSR motives. Derivative goal is to explore the underlying factors that motivate management to undertake CSR activities, and to determine how they affect the level of internal and external social responsibility.

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Attempts to define corporate social responsibility began in the mid-twentieth century, but even today there is no universally accepted definition. One of the first definitions is given by Howard R. Bowen (1953): "*Social responsibility refers to the obligations of businessmen to pursue those policies, to make those decisions, or to follow those lines of action which are desirable in terms of the objectives and values of our society*". However, the conceptualization of social responsibility as the obligation is subject to denial in contemporary approaches. One of the latest interpretation of the concept of CSR is one by the European Commission (2011, p.3.) that explains social responsibility as a concept in which companies voluntarily integrate social and environmental issues in their business operations and in their interaction with stakeholders. So, it is about activities that cross the border of obligations prescribed by law, and are based on altruism and philanthropy. The company should be responsible in relation to its internal and external environment, and to all stakeholders, such as employees, business partners, suppliers, customers, governments, non-governmental organizations, who represent the interests of local communities and the environment, and society in general. But above all, they must be able to make a profit that allows a sustainable competitive position. In order to achieve this, CSR must be effectively managed and supported by adequate organizational structures (Vlastelica Bakić, et al., 2015).

Although the socially responsible behavior is often seen in the context of external responsibility towards the environment, we should not neglect the inner dimension which mainly relates to employees. *Internal dimension of social responsibility* involves taking care of employees' health and safety at work, beyond the limits imposed by law. It includes respect for individual differences and problems that members of the collective are facing, promoting humanity and concern for people, which is not limited to the working hours but also includes an attempt to achieve a balance between work, family and leisure time. Extremely important dimension of internal responsibility relates to equal opportunities for training and learning. *External dimension of social responsibility* applies to all external stakeholders, ranging from clients to business partners, local communities, and national levels, and often the wider regional and even global environment (Stojanović-Aleksić & Bošković, 2015).

In answering the question of why companies implement social responsibility, we should start from the results of previous studies, which point to the various factors of motivation. First, it is useful to consider the main benefits of this way of doing business for the company, since they can represent important motivators. In the market economy and extreme competition in the global market, economic motives play an important, and perhaps even the most significant role in making decisions on the implementation of socially responsible activities, which is totally understandable. After all, companies are profit organizations, and it is illogical to expect from them to take actions that are inconsistent with the goal of achieving positive financial results. No matter what, the economic dimension is still the first one within the pyramid of social responsibility (Carroll, 1991). However, the link between CSR activities and financial performance is very difficult to measure, and previous research has lead to conflicting results. A group of authors conducted a meta-analysis that included 192 studies on the above relationship, and a survey showed the existence of a positive, statistically significant but small effect ($r = 0.132$) of the CSR on financial performance (Margolis et al., 2007). Present difficulties in quantifying this interdependence are primarily reflected in the fact that the financial effects of social responsibility are difficult to measure in the short term, and that this area of business, by creation of intangible resources, has many positive implications in the long term. An organization directly or indirectly generate a series of benefits through CSR, including: strengthening the brand, improving the image, strengthening the ability to attract, motivate and retain employees and consumers (Kotter & Lee, 2005, p.12), which in the long run leads to a reduction in operating costs and improvement of the competitive position (Porter & Krammer, 2006). Besides the enhancement of the share in the domestic market, CSR can be seen as a determinant of international success (Mitic, 2007). In terms of globalization, public pressure is growing and forcing international companies to coordinate their activities with the requirements of the community. In fact, CSR is not an innovation any more, since vast majority of international and multinational companies apply this concept. Moreover, it is one of the key prerequisites for success in the global marketplace. In addition, irresponsible behavior, if it finds the condemnation of the public and consumers, mainly causes high

losses, which are difficult to compensate. Accordingly, the potential positive effects, even in a very long period, are far more profitable than any possible harm to the company. In addition, studies have shown that the involvement of companies in socially desirable activities, leads to greater employee satisfaction (Koh & Boo, 2004) and their positive emotions (Onkila, 2015). Therefore, social responsibility can play an important role in retaining existing workforce, but also in attracting new high-quality workers, affecting the perception of people on the organizational culture as friendly and humane.

However, social responsibility should not be seen only as a means to improve business results. Aguilera et al. (2006) distinguish between instrumental, relational and moral CSR motives. The *instrumental motives* are related to the previously explained efforts to reach certain financial benefits by engagement in CSR. *Relational motives* are related to conformation with emerging industry norms, while *moral motives* explain the tendency to be operating in accordance with the beneficiaries' best interests. Managers, encouraged by moral motives, engage in CSR due to a higher purpose to help humanity. Particular attention should be paid to the interdependence of CSR motives and the level of CSR development. Starting from this presented model, Dare (2016) analyzed the impact of these three groups of motives on CSR commitment and proved that firms with a dominant moral motive tend to hold a higher commitment to CSR than firms with a dominant instrumental motive.

On the other hand, Munilla & Miles (2005) started from the theoretical framework developed by Van Marrewijk (2003), which is shown in Table 1. However, they classified motives into three groups: *strategic motives*, referring to the observation of social responsibility as an investment in improving operations and competence; *compliance driven motives*, referring to the observation of CSR as an obligation to society and *force driven motives*, ie. CSR expenditures perceived as a "tax" being mandated by NGOs or other external stakeholders that will diminish the firm's ability to create value for other relevant stakeholders. The same authors argue that strategic orientation can positively affect employees' contribution to creating added value for customers and the local community, while observing CSR as forced may adversely affect the motivation of employees, which leads to the alienation of certain groups of customers and a negative reputation among stakeholders, who represent the local community. Compliance driven motives showed no particular impact on any aspect of social responsibility.

Table 1: CSR motives according to Van Marrewijk (2003)

CSR motives	
Compliance	CSR as a social obligation - perception of CSR expenditures as simply a cost.
Profit	CSR as a strategic initiative - using CSR to create competitive advantage and superior financial performance. CSR expenditure perceived as an investment.
Caring	Using CSR to balance the triple bottom line of profits, people, and planet. Social and/or environmental responsibility trumps economic responsibility.
Synergistic	Use of CSR to attempt to create a "sustainable corporation". Social and/or environmental responsibility is strategically used to create competitive advantage and meet the corporation's economic responsibilities.
Holistic	CSR as a corporate culture. Social and/or environmental responsibility is strategically used to create competitive advantage and meet the corporation's economic responsibilities.

Source: Munilla, L.S., Miles, M.P. (2005). The Corporate Social Responsibility Continuum as a Component of Stakeholder Theory, *Business and Society Review*, 10 (4), p. 377.

Starting from the presented theoretical conceptualization and the results of previous research, we occupy a relatively different perspective on the problem. In this paper, we analyze several major groups of motives for CSR. Primarily, these are *instrumental motives*, which include strengthening the brand and corporate image, improving competitive advantage and increase of profits. Instrumental motives are viewed as utilitarian, because they are based on the principle of utility. Observation of CSR as a mean for achieving these goals can result in a greater involvement of the company in all aspects of external CSR, since activities, such as humanitarian actions, actions with the aim of contributing to culture, sports, environmental protection and publication of information about CSR, are often widely promoted and can directly affect financial results. The second group refers to *philanthropic motives*, which in this study encompass the tendency to increase employee satisfaction, and the different motives of moral or ethical character. Companies, whose management is encouraged by these reasons for investing in CSR, should have a higher level of internal CSR, i.e. concern for the welfare of employees. Besides, it can be expected that these motives have a positive effect on all aspects of CSR. The third category refers to an *obligation* to meet the requirements of adopted international quality standards. The paper starts from the assumption that these reasons, in the

absence of other motives, indicate an underdeveloped awareness of the importance of CSR and can have a negative impact, both on internal, and on external social responsibility.

Starting from the theoretical foundations and the results of previous empirical results, we developed a set of hypotheses which are practically tested. The hypotheses are:

H0: The level of CSR will be different among companies, if there are different CSR motives.

H1: The level of internal social responsibility will be higher, if the motives are philanthropic.

H2: The level of external social responsibility will be higher, if the motives are instrumental.

H3: The level of CSR will be lower if CSR is viewed solely as an obligation to respect the adopted international quality standards.

3. DATA AND METHODOLOGY

3.1. Methods for data collection and processing

Besides an overview of the current domestic and foreign literature, in order to develop an adequate theoretical basis as the starting point, we realized an empirical research by distributing the questionnaire in the period from March to June 2015. The sample consisted of 24 corporations, including 80 respondents, managers of various hierarchical levels in corporate sector in the territory of the Republic of Serbia. Their answers are the primary data, based on which we derived conclusions on various aspects of CSR, as well as the most important CSR motives.

Data analysis was performed using relevant methods and techniques of software Statistical Package for Social Sciences (SPSS) 20.0. We analyzed the structure and characteristics of the sample, using descriptive statistics. Reliability of a scale was analyzed using Cronbach's Alpha coefficient, with the calculated reliability of measurement scales, which amounts to 0,890, indicating a high degree of reliability, since the questionnaire consists of 30 items. One-way ANOVA was applied in order to test the hypothesis, i.e. to determine statistically significant differences in terms of social responsibility in corporation with different dominant CSR motives.

As an instrument for data collection, we used an adapted questionnaire that consists of 30 questions. The starting point for creating questionnaire are empirical studies conducted by the Dam & Scholtens (2012), Oh et al (2011), Sánchez et al (2011) and a questionnaire of Serbian Chamber of Commerce, developed for comprehensive research in order to select the most prominent organizations in this field. Renovated structure of the questionnaire is the result of authors' original scientific approach, according to a defined subject and objectives of the research. *The first part* of the questionnaire includes questions on key CSR dimensions. The respondents answered the questions, on the basis of the degree of agreement with the statements, using a five-point Likert scale. *Second part* consists of closed questions about CSR motives. General information about respondents were collected from the five questions that make up *the third part* of the original questionnaire, and relate to gender, age, position in the organization, years of service and level of education.

3.2. Sample

On the basis of random selection, we contacted more than 60 companies and distributed 233 questionnaires. However, 80 respondents from 24 companies responded the call. Genders are equally represented in the sample. The most numerous are the respondents in the age category 36-45 years (48.8%) and the sample mainly consists of respondents with 16-25 years of service (38.8%). As for formal position, operational managers (51.3%) are dominant in the sample, immediately followed by middle management (42.5%), while the top management ranks 6.3 % of the sample. The low percentage of members of the highest level is caused by difficulties in contacting these subjects, as well as their poor motivation for participation in scientific research.

4. RESULTS AND DISCUSSION

According to Central limit theorem, variables are approximately normally distributed, because sample contains a large number of observations (n=80). Hence, we applied One-way ANOVA to compare statistically significant differences between multiple subsamples, i.e. to determine differences in terms of CSR in corporation with different dominant CSR motives. Levin's Test (Table 2) confirms the assumption of the homogeneity of variance (p>0,05 for each CSR aspect and CSR-total).

Table 2: Test of Homogeneity of Variances

	Levene Statistic	p
Internal CSR	1,284	,280
Customers	1,915	,102
Environment	,598	,701
Community	2,359	,051
CSR disclosure	1,237	,301
CSR - total	,453	,810

Source: Authors

The most important results of ANOVA and appropriate descriptive indicators are presented in the Table 3 and analyzed below. Also, we derived conclusions about the relationship between the CSR motives for and the level of CSR development, in accordance with the objectives of the research.

Table 3: Differences between CSR dimensions depending on CSR motives

	Motives	Brand and image		Competitive advantage		Profit		Employee satisfaction		Moral and ethics		International standards				
CSR dimensions		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	F	p	ε^2
	Internal CSR	3,28	0,64	3,10	0,53	2,95	0,69	2,71	0,90	**3,67**	0,52	2,50	0,30	***4,74***	***0,00***	***0,24***
External CSR	Customers	4,22	0,63	4,10	0,60	3,90	0,62	3,90	0,26	4,26	0,64	4,00	0,16	0,96	0,45	
External CSR	Environment	3,75	0,72	3,55	0,83	3,80	0,84	3,30	0,76	3,78	0,71	3,00	0,59	1,12	0,36	
External CSR	Community	**4,55**	0,68	3,55	0,98	4,04	0,94	4,10	1,05	4,10	1,19	2,95	1,45	***2,73***	***0,03***	***0,16***
External CSR	CSR disclosure	**3,52**	0,84	2,31	0,76	2,88	1,22	2,63	0,88	2,95	1,04	2,44	0,72	***2,69***	***0,03***	***0,15***
	CSR - total	**3,86**	0,51	3,36	0,53	3,52	0,59	3,33	0,61	3,78	0,62	**2,98**	0,41	***2,93***	***0,02***	***0,17***

Source: Authors

Statistically significant differences were identified in three out of five observed aspects of CSR, namely internal CSR (p = 0.00<0.05), responsibility to the community (p = 0.03<0.05), and CSR disclosure (p = 0.03 <0.05), as well as at full scale CSR (p = 0.02<0.05). Also, we calculated Eta square for each aspect and results indicate high influence in Internal CSR (ε^2 = 0.24), Community (ε^2 = 0.16), CSR disclosure (ε^2 = 0.15), as well as in CSR total (ε^2 = 0.17).[1] Therefore, the basic hypothesis ***Ho is confirmed***. In addition, the level of internal CSR is the highest in companies whose management stated morals as the most important reason for CSR (Mean = 3.67). However, internal CSR is not that high if employee satisfaction is the most important motive. Thus, this result ***partially confirms the hypothesis H1***. Responsibility to the community, as well as disclosure of CSR are the most developed in enterprises, in which CSR is seen as a means of improving the brand name and image (Mean = 4,55; Mean = 3,52), as one of instrumental motives. Based on these results, the ***hypothesis H2 is partially confirmed***, since no significant differences were identified in all aspects of external social responsibility. Also, other instrumental motives are not proved to be that important for the level of these two CSR aspects. All three statistically significant aspects, as well as the overall CSR are the least developed in companies where management pointed out fulfilling the requirements of international standards as the main CSR motive. Hence, ***H3 is confirmed***. These results are in accordance with previous research which suggest that investment in CSR is generally connected to those areas and aspects of the business that can generate economic value through social engagement (Dare, 2016, p.95).

Particularly interesting result refers to the fact that the overall corporate social responsibility is on a higher level in companies where the strengthening of the brand and image is stated to be the main motive (Mean = 3.86). This result speaks of profit-orientation of domestic companies, thus indicating utilitarianism as the

[1] According to Cohen (1988, p.284-287.) 0,01 is low, 0,06 is medium and 0,14 is high influence.

most significant set of motives for CSR. However, the high level of overall CSR is also present if the philanthropic reasons are viewed as the primary motivating factors for engaging in this field (Mean = 3.78). This means that the management is highly aware of multiple importance of CSR for the success of the company, but also values socially responsible initiatives as a kind of contribution to society, encouraged not only by adopted standards, but also by the ethical reasons. However, it should be noted that philanthropic motives should not be seen as the most important factor that leads to the implementation of socially responsible business, since companies still represent profit-oriented organizations, whose survival and development depend on the achieved results.

5. SCIENTIFIC AND PRACTICAL CONTRIBUTION

The *scientific contribution* of this paper is reflected in shedding more light on the corporate social responsibility from a theoretical point of view. The study provides relevant insights into the interdependence of CSR motives and the level of CSR, thus expanding the knowledge base in this field. These findings provide the basis for identifying strengths and weaknesses in terms of CSR in Serbia. Results also indicate the level of investment in certain aspects of social responsibility, depending on the underlying CSR motives. The results have multiple *practical implications*, as well. They indicate the need for management to expand the awareness about the importance of this approach to business. Also, the contribution is reflected in providing the basis for defining measures to improve socially responsible practices in both CSR dimensions.

6. LIMITATIONS AND FUTURE RESEARCH

The inevitable limitations of the research are identified. First disadvantage stems from the limitations of the survey, as a technique for data collection, primarily from the subjectivity of respondents. This is particularly expressed in this kind of research connected to ethical issues. Also, reluctance of representatives of companies to participate in scientific research speaks of underdeveloped cooperation between academic and professional public, which significantly complicates each research in field of business and management. As new knowledge always leads to new relevant questions, the results of this study also encourage new ideas. In future research, it would be interesting to analyze these issues in more detail, considering the interdependence between motives. Due to the fact that the sample was drawn from one specific area, this research could be extended to other countries in order to make comparative analysis and to improve the generalizability of the conclusions.

7. CONCLUSION

The results of this study are consistent with initial proposal that the level of CSR is influenced by firm's motive to engage in CSR. Specifically, we partially confirm the hypothesis that the level of internal CSR is higher in companies where philanthropic motives are dominant. Likewise, second hypothesis is partially supported because significant differences are identified only in two out of four CSR aspects, pointing to strengthening of brand and image as the most important motive in companies where external CSR highly developed. Still, external CSR is not that high in companies where increase in profit and competitive advantage are the most significant CSR motives. Findings indicate that high level of CSR in general is achieved in companies where dominant motives are those connected with the acquisition of various types of benefits for the enterprise, such as the promotion of the brand and corporate image, increase in profits and competitive advantage, which we defined as utilitarian motives, as well as in those where philanthropic motives are the most highly rated, while CSR is low in the companies where these activities are viewed as a necessity of fulfilling the obligations imposed by adopted international standards.

We can conclude that utilitarian motives play the most significant role in CSR. In this regard, it is important to emphasize that utilitarianism is different from egoism. Namely, it is not only about the aspirations to achieve good for one side (owners). It is true that management in this way, by investing in CSR, strives to contribute to the goal of maximizing profits, but also creates value for other stakeholders, i.e. for society as a whole. Social responsibility as such, in business organizations, must comply with economic interests, but it is necessary for the management to be aware of importance of CSR for the entire society. Likewise, CSR should not be taken as an obligation, since it represents an investment in the creation of sustainable competitive position. Initiatives in this area, in the long term, contribute to a number of benefits for the company and they make it easier for management to balance the interests of different stakeholders.

REFERENCES

Aguilera, R.V., Rupp, D. E., Williams, C. A. & Ganapathi, J. (2007). Putting the S back in corporate social responsibility: a multilevel theory of social change in organizations, Academy of Management Review, 32(3), 836-863. DOI: 10.2139/ssrn.567842

Aguilera, R.B., Williams C.A., Conley, J.M., & Rupp, D.E. (2006). Corporate Governance and Social Responsibility: a comparative analysis of the UK and the US. *Corporate Governance: An International Review*, 14(3), 147-158. DOI: 10.1111/j.1467-8683.2006.00495.x

Bowen, H. R. (1953). *Social Responsibilities of the Businessman*. NewYork: Harper&Row

Carroll, A. B. (1991). The Pyramid of Corporate Social Responsibility: Toward the Moral Management of Organizational Stakeholders. *Business Horizons*, 34(4), 39-48. DOI:10.1016/0007-6813(91)90005-G

Carroll, A.B. (1999). Corporate social responsibility – evolution of a definitional construction. Business and Society, 38(3), 268–295.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). New Jersey: Lawrence Erlbaum

Commission of the European Communities, (2001), *Communication from the Commission to the Council, the European Parliament and the Economic and Social Committee*. Brussels: EUR-Lex(Official Journal of the European Communities)

Commission Of the European Communities, (2001*), Green Paper - Promoting a European framework for Corporate Social Responsibility*, Brussels

Committee for Economic Development, (1971), *Social Responsibilities of Business Corporations*, New York

Dare, J. (2016). Will the Truth Set Us Free? An Exploration of CSR Motive and Commitment. Business and Society Review, 121(1), 85-122. DOI: 10.1111/basr.12082

Davis, K. (1967). Understanding The Social Responsibility Puzzle. *Business Horizons,* 10(4), 45-50. DOI:10.1016/0007-6813(67)90007-9

Devinney, T.M. (2009). Is the Socially Responsible Corporation a Myth? The Good, the Bad, and the Ugly of Corporate Social Responsibility. *Academy of Management Perspectives*, 23(2), 44-56. DOI: 10.5465/AMP.2009.39985540

European Commission, (2011), *Communication from the Commission to, the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions*, Brussels: EUR-Lex(Official Journal of the European Communities)

Freeman, R.E. (1984). *Strategic Management: A stakeholder approach*. Boston: Pitman

Garriga, E. & Mele D. (2004). Corporate Social Responsibility Theories: Mapping the Territory. *Journal of Business Ethics,* 53(1-2), 51-71. DOI 10.1023/B:BUSI.0000039399.90587.34

Margolis, J. D., Elfenbein, H. A., & Walsh, J. P. (2007). *Does it pay to be good? A meta-analysis and redirection of research on corporate social and financial performance* (Working Paper). Boston: Harvard Business School

McWilliams, A. & Siegel, D. (2001). Corporate Social Responsibility: A Theory of the Firm Perspective. *Academy of Management Review*, *26*(1), 117–127. DOI: 10.5465/AMR.2001.4011987

Mitić, S. (2007). Korporativna društvena odgovornost kao determinanta međunarodnog uspeha. *Ekonomika preduzeća*, 55(1-2), 81-92.

Munilla, L. S. & Miles, M. P. (2005). The Corporate Social Responsibility Continuum as a Component of Stakeholder Theory. *Business and Society Review*, 110(4), 371–387. DOI: 10.1111/j.0045-3609.2005.00021.x

Koh, H.C. & Boo, E.H.Y. (2004). Organizational ethics and employee satisfaction and commitment. *Management Decision*, 42(5), 677-693. DOI: http://dx.doi.org/10.1108/00251740410538514

Kotler, P. & Lee, N. (2005). *Korporativna društvena odgovornost – učiniti najbolje za svoju kompaniju i za izabrani društveni cilj*. Beograd: Hesperia

Petrenko, O. V., Aime, F., Ridge, J., & Hill, A. (2016). Corporate Social Responsibility or CEO Narcissism? CSR Motivations and Organizational Performance. *Strategic Management Journal*, 37(2), 262-279. DOI: 10.1002/smj.2348

Porter, M. & Krammer, M. (2006). Strategy and Society – The Link between Competitive Advantage and Corporate Social Responsibility. *Harvard Business Review*, 84(12), 78-92.

Onkila, T. (2015). Pride or Embarrassment? Employees' Emotions and Corporate Social Responsibility. Corporate Social Responsibility and Environmental Management, 22(4), 222–236. DOI: 10.1002/csr.1340.

Stojanovic-Aleksic, V. & Boskovic A. (2015). Corporate social responsibility: the experience of Serbia and the European Union. In M. Jakšić, V. Stojanović Aleksić, & P. Mimović (Eds.), *Economic and social aspects of Serbia joining the European Union (*255-268), Kragujevac: Faculty of Economics.

Surroca, J., Tribo,J.A., & Waddock, S. (2010). Corporate responsibility and financial performance: the role of intangible resources. *Strategic Management Journal*, 31(5): 463 - 490. DOI: 10.1002/smj.820

Vlastelica Bakić, T., Civarić Kostić, S., & Nešković, E. (2015). Model for Managing Corporate Social Responsibility. *Management*, 74, 47-56. DOI:10.7595/management.fon.2015.0002

THE IMPORTANCE OF ETHICS OF THE BUSINESS ORGANIZATIONS FOR SUSTAINABLE BUSINESS DEVELOPMENT

Ivana Erić
Belgrade Business School – Higher Education Institution for Applied Studies
e-mail: ivana.eric@bbs.edu.rs

Abstract: *The purpose of the paper is to show the importance of ethics of business organizations for sustainable business development. Aside from presenting theoretical background, this work offers the results of the empirical research. This paper shows the results of Kranet project which was conducted in 3845 companies. It also presents research about perceptions on business ethics in Serbia which were gained by interviewing 194 respondents in 5 economic organizations. The results of Kranet project are showing that our country is below the average of EU countries in the number of report on corporate social responsibility and codes on ethics. Similarly, the Business Ethics Index is under the value of 100 which suggests that our respondents feel that business ethics of organizations is relatively bad. Many areas of business ethics are precondition for sustainable business development. Only simultaneous work on economic, environmental and social initiatives can ensure the sustainable business development.*

Keywords*: sustainable business development, business ethics, business responsibility, loyalty, perceptions of business ethics*

1. INTRODUCTION

During the last decades the issue of corporate business sustainability has been increasingly receiving importance in the academic, but also in the business circles. Today, more than ever, business organizations are having an important role in encouraging sustainable development. The essence is that in modern conditions of the ruthless competitive struggle, business organizations have to ensure satisfying the needs of individuals, creating jobs and the continuous development of their own business opportunities.

In that sense, corporate business sustainability searches for ways of how business can contribute to the goals of sustainable development and how provocative opportunities can be integrated into corporate sustainability activities. Responsibility toward environment, consumers, employees, shareholders, government, lobby groups, social responsibility and others belongs to the area of business ethics in all modern organizations. Many questions of the ethics of business organizations are directly related to the issues of sustainable business development. Modern organizations report every year through the Global Reporting Initiative about their activities in sustainable business development. Similarly, many organizations inform the public about its activities in the area of corporate social responsibility and other ethical questions. In both cases, the intention of organizations is to obtain the loyalty of all interested stakeholder, as well as key assumptions for the success and long-term capacity for the sustainable business development.

In continuation of the work it will be shown the basic concept of the sustainable business development and the model of business ethics, how should be pointed out the importance of ethical image of the organization for sustainable business development. In addition, it will be shown the results of the research project Kranet about the existence of written reports on corporate social responsibility and business ethics. Finally, in this paper will be presented the perceptions of business ethics in Serbia which were gained through research conducted on 194 respondents in five economic organizations in Serbia.

2. THEORETHICAL BACKGROUND ABOUT SUSTAINABLE BUSINESS DEVELOPMENT AND BUSINESS ETHICS

Generally speaking, sustainable development can include an organizations economic, environmental and social initiatives in ensuring the future, and if it is possibly better future. *James (2001) think that "purpose of the economic development is to generate wealth, especially for poorer people, in ways that are compatible with the systematic eliminating pollution of the environment and nature and contribute as much as we can to the meeting of human needs in our society" (p. 77).* In that sense, corporate business sustainability seeks ways how business can contribute to the goals of sustainable development and how to integrate provocative opportunities into corporate sustainability activities.

The essence is that organizations can achieve business objectives with respect for their economic, social and environmental duties. According to *Rainay (2010) "sustainable business development involves formulating and implementing business strategies, innovations and initiatives to help create a more*

sustainable world. It is philosophical perspective that permanents every aspects of what corporation is, the job of management is not supervision, but leadership" (p. 29). Another interesting view is presented by *Linton and others (Linton, Klassen and Jayaraman, 2007) who see sustainable business development as "using resources to meet the needs of the present without compromising the ability of future generations to meet their own needs" (p. 1076).* In fact, all definitions have in common existence of ethical leadership, which will seek to create a better world for all members of the human community with respect to the economic purpose of business organizations.

On the other side, ethics of business organizations basically includes economic, environmental and social responsibility. According to its essence, it is not oriented only towards better economic results, but also to satisfy the interests of all concerned stakeholders. In some cases, business organizations can consciously accept the loss of profit for the sake of positive ethical image. *Holmes (2008) pointed out that „business ethics can be defined as a set of moral principles for decision-making within the organization's values, which should explain the principles of conduct in accordance with standards of right and wrong" (p. 249). According to Thoms (2008) business ethics is "the systematic study of business ethics perspective, referring to the need, and should not, and suggests the existence of standards above and beyond regulation" (p. 419). "Business ethics is the study of conflict, the conflict between the economy and values between competition, trade and capitalism, between morality, integrity, and accountability" (Wheeler, Fabig and Boele, 2002, p. 298).*

It is obvious, that none of presented definitions are not able to explain all the complexity of this phenomenon, partly due to the influence of different perspectives on ethics. Instead, *Svenson and Wood (2008) are proposed the model of business ethics which seeks to explain the phenomenon of business ethics and the ways in which we, as a society, interact with the concept (p. 303).* It is transformational, simultaneous, continuous, iterative process of creating three main components: the expectations, perceptions and evaluations, which are connected with five subcomponents (expectations, organizational values, norms and beliefs; outcomes, assessment of society and reconnection). So there does not exist real final end of this model, but instead it represents the permanent reconnection and evaluation of all parts of this continuous process (Figure 1).

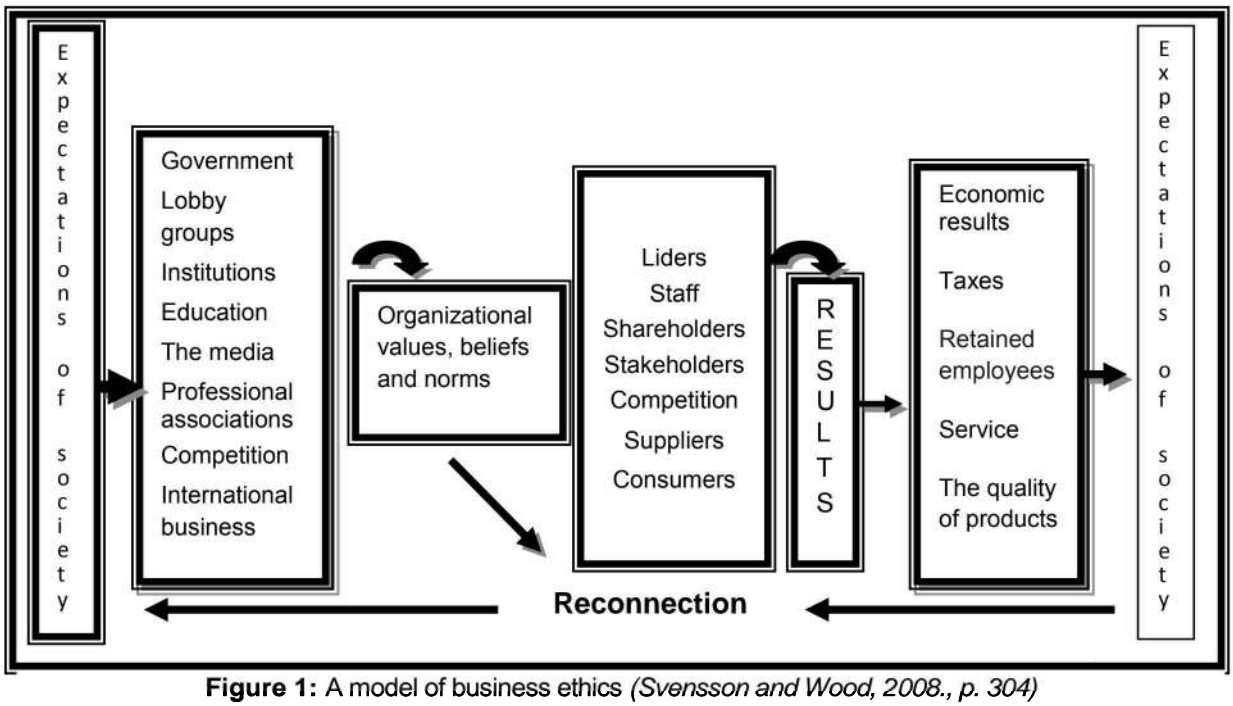


Figure 1: A model of business ethics *(Svensson and Wood, 2008., p. 304)*

The first component of a model are expectations of society about the expression of organizational behavior that allows further progress of the community in the realization of a higher level of well-being. The second component of the model consists of expectations: legislation, lobby groups, institutional responsibility, higher levels of education, media, socially responsible managers, professional associations, competition and international business with integrity. The legislation includes a whole set of laws for the creation of acceptable business behavior in the community. Lobby groups have the power to spread information, gathering disgruntled individuals and the destruction of individual business enterprise. The institutional responsibility of organization implies their participation in creating better society, through the concept of social responsibility and the creation of new laws, not just as an economic responsible entity. Enlarged level of education is predominantly a tool for change expectations, therefore it is necessary to discuss and

rationalize a number of questions. Socially responsible managers are required for contemporary organizations, and the managers who will do the right thing, make the right decisions and engage in actions that society expects, not because of fear of punishment, but because of its personal feeling. Professional associations have rules that are binding and protect all members, for the sake of achieving the highest standards of conduct in all organizations they work for. At the end, competition expects fair, just and clean fight. However, it often happens that organizations use cunning tactics, for the sake of increasing market share and survival in general.

The third component of the model - the organizational values, norms and beliefs, were created partly through affirmation of the characteristics of its members, and partly were based on expectations of stakeholders. The fourth components of model are perceptions, i.e. the way in which society perceives the behavior of organizations as ethically vs. unethically. Perceptions are considered through relationships of organizations with leadership, employees, shareholders, suppliers, customers, competitors and other stakeholders. The outcomes or results are the fifth component of the model, which measure not only a level of profit, but primarily the influence of the organization on society, through its activities or inactivity. Finally, the sixth component includes the evaluation and assessment of the organizational performances by members of society. The criteria used in the evaluation are the following: economic performance, respect for the law, retention of employees and consumers, acceptability of products and evaluation of society.

After evaluation of results of the organization it will be formed a new level of expectations (usually higher), in terms of organizational functioning, which becomes a basis for judging about ethics in the next cycle. Very often the assessment of one cycle will lead towards the creation of new laws, which will set more obstacles for illegally and immorally behavior.

The importance of business ethics for sustainable business development is undoubtedly great in the opinion of many scientists and companies. *Researchers cite the following essential reasons or motives for ethical behavior of modern organizations in terms of sustainable business development: organizational reputation, motive of managers, employees motive and the motive of investors (Trevino and Nelson, 1999; Weiss, 1998). The influence of the media on the ethical image of the organization is significant with respect that it publicly expresses positive and negative examples of ethical action, and thus it tries to create public opinion. (American Management Association, 2006).* Managers care about ethics because they can face with serious problems in the prevention and management of unethical behavior of employees. *Employees, who perceive to work for something "more" than the mere profit, demonstrate a higher degree of loyalty, satisfaction, better communication and commitment to the organization (Ethics Resource Center and Hay Group, 2012*). Finally, investors and owners have motives to think about the ethics of the organization. They invested their capital, so it is realistic to expect that they can ask questions such as: "Does the organization achieve higher profit?, and/or “Does the organization achieve profit in an ethical way?". Any kind of unethical activities can jeopardize the reputation of the organization and thus it can decrease the rate of return on investments. All this reasons imply that are very important to behave on the ethical way if the organizations want to have sustainable business development.

3. RESEARCH

The only comprehensive study, which attempted to investigate the current situation in the field of business ethics in our country, is the research conducted at the Faculty of Economics in Subotica in cooperation with Cranfield School of Management from the UK. *The survey was conducted in the period 2008-2010., on a sample of 20 countries of the European Union and Serbia and a total of 3845 companies (Economic Faculty of Subotica, 2011).* The research was aimed at obtaining answers to the question about the existence of written statements of corporate social responsibility and the written code of ethics. Respondents answered the question: "Does your company have a statement on corporate social responsibility?”. The possible responses were: Yes, written; Yes, unwritten; and No. The research results are shown in Figure 2.

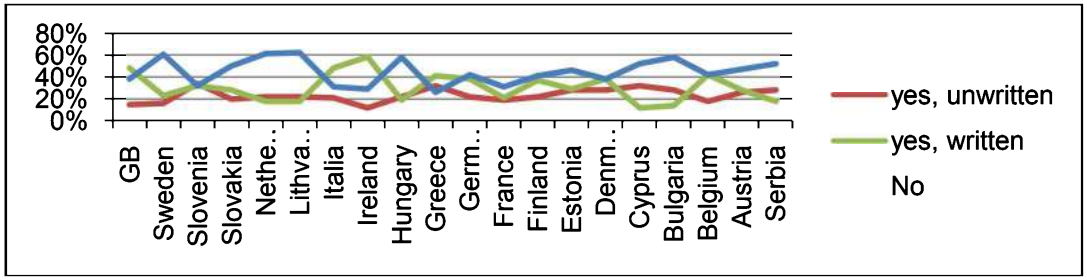


Figure 2: The existence of a written report on corporate social responsibility *(Economic Faculty of Subotica, 2011)*

The average of the European Union countries, concerning the existence of statement on corporate social responsibility is 55.2%, of which 32% is written and 23.2% is unwritten. Our country is a little under the average with only 46.1% of organizations which have statement on corporate social responsibility, i.e. 17.9% is written and 28.2% is unwritten. It is very devastating fact that even 53.8% of the surveyed organizations do not have a statement of corporate social responsibility. The best countries are the United Kingdom (47.5%), Ireland (58.3%), Italy (47.4%) and Belgium (41.9%), in terms of the written statement on corporate social responsibility. The former socialist countries like Slovakia, Hungary, Bulgaria and Serbia have shown significantly lower incidence of the declaration on CSR (between 14% and 28%) or moderate level of oral statements about CSR (between 22.7% and 34%).

On the other hand, the same study asked the question: "Does your organization possess a code of ethics?". Respondents were answered with: Yes written; Yes, unwritten; No. The results are shown in Figure 3.

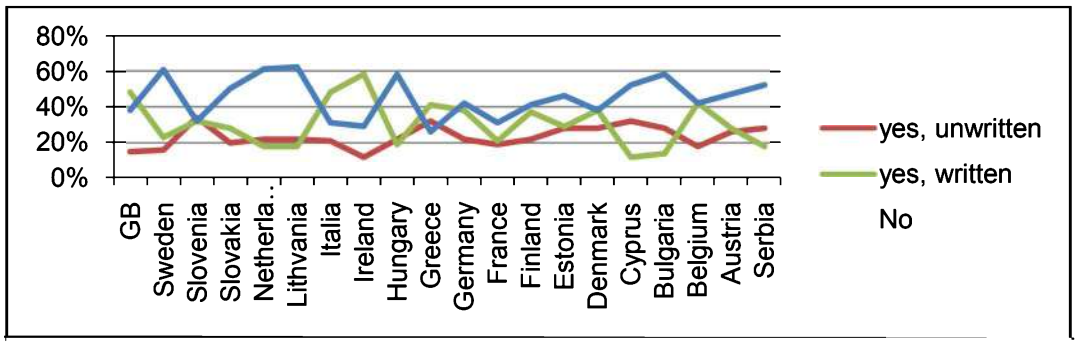


Figure 3: The existence of written codes of ethics *(Economic Faculty of Subotica, 2011)*

Situation is much better when we compare existence of written codes of ethics with written report on corporate social responsibility. The average of the European Union is 60%, of which 45.1% of the organizations possess written, and 24.9% of the organizations have unwritten codes of ethics. Significant negative deviation from the average of the EU demonstrate Netherlands (9.5% of written codes of ethics), Germany (37.7% of written codes of ethics), and Austria (25.5%). The only logical explanation would be that the above mentioned countries have highly developed ethical values as a part of the organizational culture, because their business practice are regulated systematically. Perhaps because of this, organizations do not feeling the need for formal prescribing of ethical values. However, the question arises to what extent was the code of ethics real implemented, or whether only represents a formal document. The future will give us the answer to such a complex issue.

The second research was conducted by the author of this paper and within there were analyzed past and future perceptions about business ethics in Serbia. *The research lasted for about 7 months, in period from March to November 2012 (Eric, I., 2014).* The technique of direct structured interviews was applied, due to lack of adequate secondary information's, and for all respondents were guaranteed anonymity.

Table 1: Socio demographic structure of the respondents

Organizations	**Eco**	**Piraeus**	**Marfin**	**Deles**	**Simpo**	**Sum**
Frequency (percentage)						
Number of respondents	13(6,7%)	35(18,04%)	41(21,13%)	72(37,11%)	33(17,01%)	194(100%)
Gender						
Male	8(61,54%)	11(31,43%)	20(48,78%	33(45,83%)	16(58,58%)	88(45,36%)
Female	5(38,46%	24(68,57%)	21(51,22%)	39(54,16%)	17(51,51%)	106(54,64%
Sum	13(100%)	35(100%)	41(100%)	72(100%)	33(100%)	194(100%)
Education						
Secondary educ.	6(46,15%)	4(11,43%)	8(19,51%)	28(38,89%)	11(33,33%)	57(29,38%)
High education	5(38,46%)	11(37,43%)	10(24,39%)	32(44,44%)	12(36,36%)	70(36,28%)
Doctoral educ.	2(15,38%)	20(57,14%)	23(56,09%)	2(2,78%)	10(30,30%)	57(29,38%)
Sum	13(100%)	35(100%)	41(100%)	72(100%)	33(100%)	194(100%)
Age						
Young	4(30,79%)	13(37,14%)	8(19,51%)	28(38,89%)	6(18,18%)	59(30,41%)
Mean age (30-50)	5(38,46%)	15(42,86%)	10(24,39%)	29(40,28%)	15(45,45%)	74(38,14%)
Older (50+)	4(30,79%)	7(20%)	23(56,1%	15(20,83%	12(36,36%)	61(31,44%)
Sum	13(100%)	35(100%)	41(100%)	72(100%)	33(100%)	194(100%)

***(Source**: Calculation of author)*

Perceptions of individuals about the level of business ethics in companies were examined through a special construct called Business Ethics Index (BEI - Business Ethics Index). The index measures the sensation (perception), current and future attitudes of consumers or clients on the overall situation of ethical business practices. It is consists of four components: BEI personal/past, BEI vicarious/future, BEI personal/future and BEI vicarious/past. *The formula to calculate BEI personal/past and BEI vicarious/past is (Tsalics and Seaton, 2006, p. 320):*

$$\frac{(\%\ very\ ethical - \%\ very\ unethical) + (\%\ somewhat\ ethical - \%\ somewhat\ unethical)}{2} + 100 \quad (1)$$

Calculation of vicarious / future and personal / future will do according to the following formula:

$$(\%\ more\ ethical - \%\ more\ unethical) + 100 \quad ...(2)$$

The final BEI (Business Ethics Index) is obtained by adding relative value components of the index and dividing by four. All final value of BEI, which are more than 100 demonstrate positive perceptions about the level of business ethics in organizations, and below 100 bad images about the ethical practices of organizations. The remainder of this paper will present the results of research.

Table 2: Perception of business ethics on the basis of perception in past

	Based on past experience, the business is generally observed	%	Based on what you heard in the past business is observing	%
Very unethical	51	26	51	26
Somewhat unethical	90	46	46	23
Neither ethical nor unethical	6	3	17	9
Somewhat ethical	37	19	138	70
Very ethical	12	6	24	12

(***Source***: *Calculation of author)*

Table 2 presents the data for the value of the components BEI, which are related to the experience of individuals with regard to the practice of business ethics in the past. On this basis, we can say that is the past BEI = 69, which means that our respondents think that business ethics in the past was very bad observed by all parameters.

Table 3: Perception about business ethics in the future

	Based on your previous experience what do you expect	%	Based on what you've heard, business will act in the future	%
More unethical	42	21	43	22
Same	96	49	61	31
More ethical	58	30	92	47
Sum	196	100	196	100

(Source: *Calculation of author)*

Table 3 shows the values for the components of BEI, which refer to the attitudes of individuals for the practice of business ethics in the future. Based on the results, we can say that is the future BEI = 117, and that the respondents believe that organizations in our country will become more ethical.

Calculating the value of BEI past and BEI future by previously presented formula we find that the value of the BEI index for our country is 91. This value suggests how our respondents feel that business ethics of organizations on our territory is relatively bad. However, the main reason for such a very small value of BEI - less than 100, is a result of bad BEI past. Expectations on ethics of business organizations in our country are very positive, as can be clearly observed through the current practices of organizations.

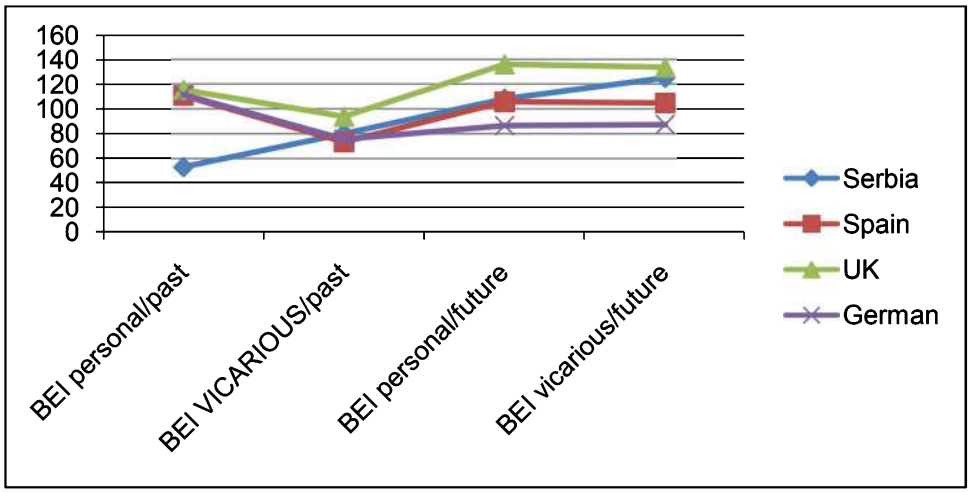


Figure 3: The value of BEI components for four countries (***Source***: *Calculation of auth*or)

Figure 3. shows the components of the index of business ethics for the four countries (Calculation of author on the own research; Tsalics and Seaton, 2006). By comparing data we can say that Serbia has the lowest value of the components of BEI personal/past, which shows that personal experience of business ethics in the past is very bad. It is interesting to note that all other values are more than the value of countries such as Spain and Germany, which should be seen as a "highly ethical". Therefore, according to the opinion of the author of this paper, our country is not "much worse" than other countries with developed market economy, as well as many individual claims. Moreover, we can expect a bright future in terms of ethics of business organizations, which operate in our country.

4. CONCLUSION

In this paper is shown all the importance of ethics of business organization for sustainable business development. Organizational reputation, satisfaction of managers, employees loyalty and the interest of investors for investing depend on the ethical image of the organization. Positive perceptions about ethics of the business organizations will be precondition for sustainable business development. It means that any kind of moving forward (in business sense) is not possible without trust of all interested stakeholders and, also it is indispensable that organization behaves in ethically acceptable way. The paper offers the results of the two empirical researches. The first researches are showing that our country is below the average of EU countries in the number of report on corporate social responsibility and codes on ethics, which is not so bad result. The second research about the business ethics suggests that our respondents feel that business ethics of organization in our county is relatively bad. These results are not surprising. Very high level of unemployment, economic crisis, problems with payment debts, problems with creating new business opportunities and others, have placed requirements in front of many organizations with a view to create mere economic survival. In those conditions, just brave organizations can integrate economic, environmental and social initiatives in ensuring the better future.

REFERENCES

American Management Association. (2006). The ethical enterprise: Doing the right things in the right ways, today and tomorrow- A global study of business ethics 2005 – 2015. Retrieved from http://www.amanet.org/HREthicsSurvey06.pdf

Ekonomski fakultet Subotica. (2011). Baza podataka istraživačkog tima Kranet projekta. Retrieved from http://kranet.org.

Erić, I. (2014). *Etičko-moralne orijentacije ponašanja čoveka i organizacione kulture*. (Doktorska disertacija). Ekonomski fakultet Subotica, Srbija.

Ethics Resource Center, & Hay Group. (2010). Ethics and employment engagement – 2009: National business ethics survey. Retrieved from http://ethics.org/files/u5/NBESResearchBrief2.pdf.

Holmes, C. (2008). Business ethics –Part one: Does it matter?. *Industrial and Commercial Training, 40*(5), 248-252. doi.org/10.1108/00197850810886487

James, P. (2001). Towards sustainable business? In M. Charter,& U. Tischner (Eds.), *Sustainable solutions: Developing products and services for the future,* 77-97. Sheffield, UK: Greenleaf Publishing.

Linton, J. D., Klassen, R., & Jayaraman, V. (2007). Sustainable supply chains: An introduction. *Journal of Operations Management*, *25*(6), 1075-1082. doi:10.1016/j.jom.2007.01.012

Rainey, D. L. (2010). *Sustainable business development: Inventing the future through strategy, innovation, and leadership*. Cambridge, England: Cambridge University Press.

Svenson, G., & Wood, D. G. (2008). A model of business ethics. *Journal of Business Ethics, 77*(3), 303-322. doi: 10.1007/s10551-007-9351-2

Thoms, J. S. (2008). Ethical integrity in leadership and organizational moral culture. *Leadership*, *4*(4), 419-442. doi: 10.1177/1742715008095189

Trevino, L. K., & Nelson, K. A. (1999). *Managing business ethics: Strait talk about how to do it right* (2nd ed.). New York: John Wiley and Sons.

Tsalics, J., & Seaton, B. (2006). Business ethics index: Measuring consumer sentiment toward business ethics practices. *Journal of Business Ethics, 64*(4), 317-326. doi: 10.1007/s10551-005-4667-2

Weiss, J. W. (1998). *Business ethics: A stakeholders and issues management approach* (2nd ed.). Orlando, Florida: The Dryden Press, Harcourt Brace & Co.

Wheeler, D., Fabig, H., & Boele, R. (2002). Paradoxes and dilemmas for stakeholder responsive firms in the extractive sector: Lessons from the case of Shell and the Ongon. *Journal of Business Ethics, 39*(3), 297–318. doi:10.1023/a:1016542207069

CONSISTENCY OF THE EUROPEAN COMMISSION'S ASSESSMENT OF PROPOSED MERGERS IN AIRLINE SECTOR

Danica Babić*[1], Dejan Pavlović[2]
[1]University of Belgrade – Faculty of Transport and Traffic Engineering
[2] University of Belgrade – Faculty of Political Science
*Corresponding author, e-mail: d.babic@sf.bg.ac.rs

Abstract: *This paper provides an overview of the merger cases in the airline industry that the European Commission has dealt with during the past decade with respect to the conclusions and the remedies applied. Airline mergers play a key role in the EU airline industry and represent regular way for airlines to restructure, become more efficient, productive and, in the long-run, to survive in the market. However, antitrust law underpinning mergers in EU market sometimes may seem like a limiting factor of the fair and free market development. The analysis of the merger cases in EU presented in this paper raises a number of interesting legal and economic questionsrelated to the consistency in application of the criteria for assessing the mergers.*

Keywords*: airline mergers, EU Commission, EU common market, competition, remedies*

1. INTRODUCTION

For many years air transport was a tightly regulated industry, where investment and operating decisions were highly constrained. Under regulation period, the airlines did not have the freedom to set prices, frequencies and routes, while the market entry and exit was strictly controlled. In Europe, the airlines were state-owned and all international routes were arranged by bilateral agreements between the respective governments. The deregulation and liberalization of the European Union (EU) market has significantly changed the competitive environment and the nature of the airline competition. In the years following the deregulation, the number of competing airlines entered the market, fares significantly dropped and passengers' choices multiplied. However, over the last 20 years, many of the national airlines did not survive, some have withdrawn or been acquired by other airlines. Others, however, were restructured and developed into a full-service carriers (FSCs), became much stronger and continued to compete. Even if the first effect of deregulation was the emergence of new competitors, very soon many airlines began to merge resulting in much higher concentration of the contemporary airline industry in comparison to the pre-deregulation era.

The air transport sector is inherently oligopolistic. There is very high base cost in this type of services, while the consolidation of a carrier's operations at a large hub airport has various operational and cost advantages, such as reduced expenses due to fewer technical facilities for aircraft maintenance, scheduling advantages, etc. (Kociubinski, 2013). Economy of scale is in the nature of air transport.

Mergers and acquisitions intensified after the air transport deregulation and represent an important structural adjustment for the sake of an airline's competitiveness. Merger is often seen as a possible means for improving airline's efficiency and productivity. It provides an opportunity for restructuring, a more efficient allocation of resources, for achieving economy of scale and scope by extending marketable networks, enhancing access to markets, etc. (Iatrou & Oretti, 2007). There are also the benefits for consumers that arise from the larger networks with more frequent and convenient flights. Very often, mergers were one means of solving the financial difficulties of the airlines, that if there would be no merger led to its bankruptcy and withdrawn from the market. With that withdrawing from the market it would be lost of one competitor anyway, resulting in less competition than it would be if the merger is approved.

However, mergers may also have negative effects on competition in the market, by reducing the number of competitors, that can lead to weakening the competition (caused by the increased market power of emerged airline) and creating more barriers to entry. Although, merger can lead to impairment of competition in the short term, if this happens and there are no significant barriers to entry, the market forces will ensure the recovery of competition in the long term (Begović, 2010).

All this can result in the more concentrated market than it was before the merger occurred, but the prohibition of the merger can nullify all the potential benefits considering airline's efficiency. This is why antitrust authorities must balance these conflicting interests when deciding whether to approve a merger or not. The

aim of this paper is to assess the European Commission's approach with respect to consolidation (mergers and acquisitions) in the European airline sector and the application of the EU competition law in the cases of proposed mergers. Special consideration will be given to the proposed and applied remedies in cases when Commission was reluctant to sanction the merger.

2. MERGERS IN AIRLINE SECTOR IN EU

The competition law of the EU is primarily based on the Articles 101 and 102 of the Treaty on the Functioning of the European Union (TFEU) from 2007. According to the Article 102, "Any abuse by one or more undertakings of a dominant position within the internal market or in a substantial part of it shall be prohibited as incompatible with the internal market in so far as it may affect trade between Member States". Furthermore, it provides, *exampli causa,* types of abuses that are particularly problematic: a) directly or indirectly imposing unfair purchase or selling prices or other unfair trading conditions; b) limiting production, markets or technical development to the prejudice of consumers; c) applying dissimilar conditions to equivalent transactions with other trading parties, thereby placing them at a competitive disadvantage; d) making the conclusion of contracts subject to acceptance by the other parties of supplementary obligations which, by their nature or according to commercial usage, have no connection with the subject of such contracts.

The evolution of the EU competition law related to the mergers and acquisitions effectively started with the adoption of the Council Regulation(EEC) No 4064/89 of 21 December 1989 on the control of concentrations between undertakings, also known as the Merger Regulation.The objective of the Regulation was to establish a system that would ensure the competition in the internal market is not distorted. This is the core of the principle of open market economy with free competition, embedded in the Article 4(1) of the EC Treaty. The Regulation should apply only to significant structural changes, with an impact on the market that goes beyond the national borders of any one Member State. Such concentrations should be reviewed exclusively at the EU level. The Merger Regulation represented the new Community competence, while the chief beneficiary of the new development was the European Commission. Before the passage of this piece of legislation, Commission had extensive authority in other areas of the competition policy, but no formal authority in merger control.

The current Council Merger Regulation (EC) No 139/2004 of 20 January 2004 builds on the achievements of its predecessor, the enlargement of the EU, aiming at further development of the internal market and prevention of those concentrations which may significantly impede effective competition in the common market. AS to the scope of application of the Regulation, it should be defined according to the geographical area of activity of the undertakings and be limited by quantitative thresholds – targeting those concentrations that have a Community dimension. The Commission is authorized to set and implement relevant criteria, but those criteria should be developed in a way that protect competition interests of the Member States and take due account of legal certainty. While the Commission has exclusive competence to apply the Regulation, its decisions are subject to review of the ECJ.

One of the main preliminary questions we face in our analysis relates to the definition and understanding of the *relevant market* in the EU competition law.The main aim of the Regulation was to prevent "significant impediment to effective competition" within the Common market. Such distortions happen when a subject establishes and abuses a dominant position that effectively restricts the competition in provisions of certain goods or services.What constitutes the dominant market position was defined in case *United Brands v. Commission* (Case 27/76, 1976), when ECJ found that dominant position "relates to a position of economic strength enjoyed by an undertaking which enables it to prevent effective competition being maintained on the relevant market by giving it the power to behave to an appreciable extent independently of its competitors, customers and ultimately of its consumers." (para. 65).According to the Commission notice on the definition of relevant market for the purposes of Community competition law (97/C 372/03), there are two dimensions of relevant market in EU competition law – geographic market and product market.A relevant geographic market comprises the area in which the firms concerned are involved in the supply of products or services and in which the conditions of competition are sufficiently homogeneous.

A relevant product market comprises of all those products and/or services which are regarded as interchangeable or substitutable by the consumer by reason of the products' characteristics, their prices and their intended use. The key distinction is between time-sensitive passengers and non-time-sensitive passengers.

In its judgement in "Hoffman-La Roche v. Commission" case (CJEU, Case 85/76 (1979), the Court of Justice held that "the concept of relevant market in fact implies that there can be effective competition between the products which form part of it and this presupposes that there is a sufficient degree of interchangeability

between all the products forming part of the same market in so far as a specific use of such products is concerned." (para. 28).

Over the period 2004-2015, the EC has examined 21 merger proposals that took place in the airline sector in the EU. According to the EC reports, each merger or acquisition was examined on its own merits and on a case-by-case basis. However, there is some general approach that can be in common for all investigated proposals that includes definition of the relevant market, analysis of the effects that the proposed merger would have on competition in the relevant market and final decision making. The EC may approved (with or without conditions and obligations) or prohibit the proposed merger.

Analyzing merger proposals it can be noted that 8 of them (38%) are allowed without any conditions. Clearances subject to conditions and obligations happen in 10 cases (48%), while the prohibition happened only 3 times (14%).Figure 1 shows the evolution of the mergers in the airline industry that was under the EC investigation over the 12 years concerned. The number of mergers and acquisitions that occurred in Europe is not significant in comparison to the US market. Nowadays, the top five airlines in US – United, Delta, American Airlines and Southwest Airlines – are holding over the 80% of domestic seating capacity as a result of mergers, while over 53 percent of the European market is shared between the top six airlines. One of the reasons for that is certainly the fact that is much easier to do mergers in a single country in comparison to the situation in the EU where many governments are involved in protecting their national airlines.

Conditions and obligations are actually remedies determined in order to eliminate the competition concerns identified by the EC. Of course, they have to be designed not to hinder the potential efficiency gains from the merger. In order to determine the adequate remedies the EC must predict with reasonable certainty which elements will recover competition after completion of a merger. The effectiveness of a remedy depends on whether or not they return the market to the same competition level as existed before the merger. The most common remedies applied by EC in the merger cases can be distinguished between the slotsrelated, facilities related (access to Frequent Flyer Programmes and other agreements – interlining, block-space, etc.) and other commitments.

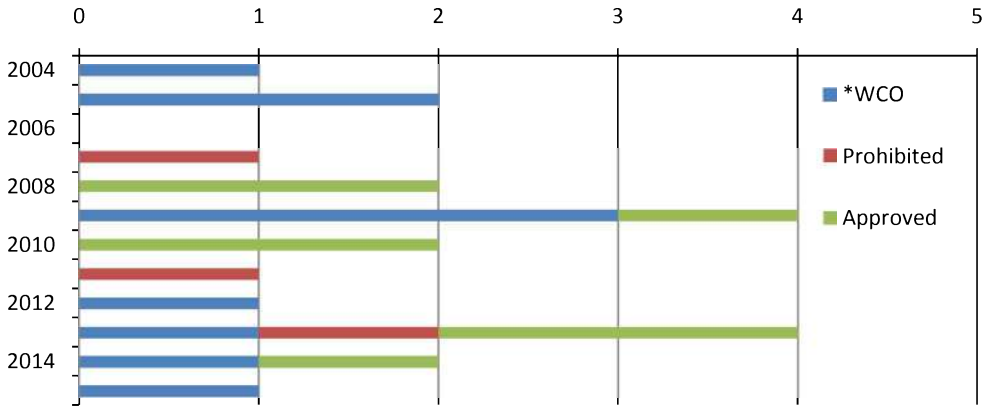


Figure 1: Mergers in EU (2004-2015)
*WCO –with conditions and obligations

2.1. Approved mergers with conditions and obligations

The list of all mergers that are proposed and considered by the EC is shown in Table 1. For each proposed merger it is indicated the year when the decision is made by the EC and in the case of the approval with conditions and obligations the applied remedies are listed.

The first airline cross-border merger in the EU was the one between two major airlines Air France and KLM. These two airlines announced their decision to create a new airline on 30 September 2003, and EC gave the clearance to merge subject to conditions on 11 February 2004. According to EC report, the airlines have complementary networks and only 14 routes are identified that will suffer from the significant reduction or elimination of competition. In order to maintain competition on the routes affected by the merger, EC approved remedies which include that both parties had to give up 47 pair of slots per day at the airports Paris Charles de Gaulle and Amsterdam Schiphol, (Case No COMP/M.3280, 2004).

In May 2005 German national carrier Lufthansa and Swiss International Air Lines announced that Lufthansa will acquire the majority of the shares in, and sole control of, Swiss. The EC's merger investigation raised

concerns about a number of intra-European routes where it may come to significant reduction or elimination of competition. In particular, the routes Zurich- Frankfurt and Zurich- Munich, and on some long-haul routes to the US, South Africa, Thailand and Egypt are most jeopardized by these potential mergers. They also took into account the impact of Lufthansa's close co-operation with members of the Star Alliance. Two months later the EC approved this merger subject to conditions and both parties committed themselves to give up slots at the airports of Zurich, Frankfurt, Munich, Düsseldorf, Berlin, Vienna, Stockholm and Copenhagen, (Case No COMP/M.3770, 2005).

Table 1: Airline mergers in EU since 2004

Merger	Year	Decision	Remedies
Air France/KLM	2004	Approved WCO	• 47 pair of slots at the airports Paris and Amsterdam (31 roundtrips per day) for the routes: • 1 roundtrip for each route from Paris to Detroit and Lagos and from Amsterdam to New York, Atlanta and Lagos • 26 roundtrips from Amsterdam to Paris, Lyon, Marseille, Toulouse, Bordeaux, Milan, Rome, Venice and Bologna • Access to Merged Entity's FFP for use by new entrants on the identified routes.
Lufthansa/Swiss	2005	Approved WCO	• Airport slots for long-haul city pairs at Zurich airport for 7 roundtrips to Boston, Chicago, Los Angeles, Johannesburg, Bangkok and Cairo. • Slots at Zurich airport for 35 roundtrips to Frankfurt, Munich, Dusseldorf, Berlin (Tegel), Hamburg, Hanover, Vienna, Stockholm, Copenhagen, Warsaw and Bucharest. • Access to Merged Entity's FFP for use by new entrants on the identified routes.
Lufthansa/ Eurowings	2005	Approved WCO	• Slots at Vienna and Stuttgart airports for 7 roundtrips for particular routes Vienna-Stuttgart, Vienna-Cologne, Stuttgart-Dresden.
Ryanair/Aer Lingus	2007	Prohibited	
KLM/Martinair	2008	Approved	
Delta Airlines /Northwerst Airlines	2008	Approved	
Iberia/Vueling /Clickair	2009	Approved WCO	• 46 roundtrips in the identified European routes: • from Barcelona to Venice, Roma, Nice and Athens • from Madrid to Venice and Naples • from Ibiza to Paris • 104 roundtrips in the identified Spanish routes: • from Barcelona to Malaga, Santiago de Compostela, Seville, Granada and Oviedo • from Bilbao to Malaga, Ibiza and Seville • from Ibiza to Seville and Valencia • from Alicante to Ibiza • from Seville to Valencia • Access to iberia's FFP for use by prospective new entrants on the identified routes
Lufthansa/Brussels Airlines	2009	Approved WCO	• Slots at Brussels airport for 10 roundtrips for the routes to Frankfurt, Zurich, Hamburg and Munich. • Access to Merged Entity's frequent flyer program for use by prospective new entrants on the identified routes.
Lufthansa/BMI	2009	Approved	
Lufthansa/Austrian Airlines	2009	Approved WCO	• Slots at Vienna airport for 19 roundtrips to Frankfurt, Munich, Stuttgart, Cologne and Brussels.
Iberia/ British Airways	2010	Approved	
United Air Lines/Continental	2010	Approved	

Airlines			
Olympic/ Aegean Airlines	2011	Prohibited	
IAG/BMI	2012	Approved WCO	• Slots at the airport in London (Heathrow) for 12 roundtrips on: • the UK city-pair routes (from London to Edinburgh and Aberdeen), in total 7 roundtrips and • the other city-pair routes (from London to Cairo, Riyadh, Moscow and Nice), in total 5 roundtrips.
US Airways/ American Airlines	2013	Approved WCO	• One daily slot pair at London Heathrow and Philadelphia airports.
Ryanair/Aer Lingus	2013	Prohibited	
Olympic/ Aegean Airlines	2013	Approved	
Delta Air Lines/ Virgin Group/Virgin Atlantic Limited	2013	Approved	
Cesky Aeroholding/Travel Service/ Ceske Aerolonie	2014	Approved	
Alitalia/Etihad	2014	Approved WCO	• 2 daily slot pairs at Rome-Fiumicino and Belgrade airports to one or more interested new entrants.
IAG/Aer Lingus	2015	Approved WCO	• 5 daily slot pairs at Gatwick airport on routes from London to Dublin and Belfast. • Aer Lingus will continue to carry connecting passengers for competing airlines out of London-Heathrow, London-Gatwick, Manchester, Amsterdam, Shannon and Dublin.

The same year EC approved another acquisition by German airline Lufthansa over the German airline Eurowings and its subsidiary, the low cost airline Germanwings. However, this clearance was conditional upon the parties to give up 7 pair of slots at Vienna and Stuttgart airports. In addition, EC conditioned the parties to allow competitors to participate with their flights on the affected routes in Lufthansa's Frequent Flyer Programme (FFP) with the aim of making entry more attractive, (Case No COMP/M.3940, 2005).

In January 2009, the EC approved under the EU Merger Regulation the proposed acquisition of the two Spanish low-cost airlines Vueling and Clickair by the Spanish national airline Iberia subject to conditions. The parties committed to release slots at Spanish airports (104 roundtrips) and other European airports (46 roundtrips) in order to address competition problems identified by the EC. The slots are linked to the particular routes in Spain and inside the Europe, where the proposed concentration would have led to a restriction of competition, (Case No COMP/M.5364, 2009).

In June 2009, EC gave clearance to acquisition by Lufthansa over the SN Brussels Airlines subject to conditions and obligations. In this case, the remedies that EC determined referred to the routes from Brussels to: Frankfurt, Zurich, Hamburg and Munich. Lufthansa agreed to offer the slots that would reduce the barriers to entry and allow new entrants to operate flights on each of the four routes where the EC identified concerns, (Case No COMP/M.5335, 2009).

In August 2009, Lufthansa officially took over the Austrian Airlines Group after the EC approved the proposed acquisition. The EC clearance is conditional upon the implementation of a set of remedies in respect to EC competition concerns on certain routes. The routes on which the EC was concerned that the transaction would result in consumers being faced with reduced choice and likely higher prices are from Vienna to Frankfurt, Munich, Stuttgart, Cologne and Brussels. In order to remove these competition concerns on all these routes, the parties commit to make slots available at the airports concerned that will account up to 19 roundtrips for new entrants, (Case No COMP/M.5440, 2009).

In 2012, the proposed acquisition of British Midlands (bmi) by IAG was approved by the EC, subject to conditions. The investigation showed that the proposed acquisition would have led to high market shares and even monopolies on a number of domestic, European and international routes out of London Heathrow airport. In order to modify the concentration so as to resolve the doubts identified by the Commission with a

view to having the merger cleared, the parties agreed to release 12 daily slot pairs at London Heathrow which could be used on the specific routes of concern, (Case No COMP/M.6447, 2012).

The only EC approval of the proposed merger between the non-EU airlines that was subject to condition was the one between US Airways and American Airlines. This clearance was released in August 2013, and the EC revealed the conditions that will adequately address the competition concerns identified by the EC. Namely, the EC's investigation found that the transaction would lead in particular to a monopoly on the London-Philadelphia route, where US Airways and American Airlines through its membership in a metal neutral joint venture with British Airways and Iberia. Both parties agreed to the release of one daily slot pair at London Heathrow and Philadelphia airports, and of other commitments in order to induce entry on the London-Philadelphia route, (Case No COMP/M.6607, 2013).
In November 2014, the EC approved Etihad's acquisition of joint control over Alitalia, subject to conditions. The decision is conditional upon both airlines' commitment to release slots to a new entrant at the airports of Rome -"Fiumicino" and Belgrade-"Nikola Tesla". The reason for this outcome is in the fact that Etihad also controls Air Serbia, which together with Alitalia, were the only carriers offering direct flights on the Rome–Belgrade route. The EC was concerned that this acquisition could lead to a monopoly on this route that will result in higher prices and a loss of service quality for passengers, (Case No COMP/M. 7333, 2014).

The most recent decision and also the clearance subject to condition released by the EC was about the proposed acquisition of Aer Lingus by International Consolidated Airlines Group (IAG). The EC concerns were raised about an insufficient competition on several routes that would be the result of this concentration. The EC's investigation also found that the merged entity would have prevented Aer Lingus from continuing to provide traffic to the long-haul flights of competing airlines on several routes. In order to adequately address all competition concerns identified, the parties committed to release the slots at Gatwick airport, while Aer Lingus will continue to carry connecting passengers to use the long-haul flights of competing airlines, (Case No COMP/M.7541, 2015).

2.2. Prohibited mergers

Since the EU Merger Regulation came into effect in 2004, three merger proposals were prohibited by the EC, under the explanation that each of them raises concerns on a number of overlapping routes and this would impede effective competition in the common market. It is interesting to examine what were the main EC findingsthat prevailed and led the EC to take a decision on the refusal of these particular merger proposals.

The first time when the EC decided to prohibit the airline merger was the one between the Irish low cost airlines Ryanair and Aer Lingus. On 30 October 2006, the EC was notified about a proposed concentration betweenRyanair and Aer Lingus. The EC biggest concern about a proposed merger was that both airlines have a strong position in Ireland and on almost all routes they were the only two or the two main carriers active. In particular, the EC found that there would be 35 routes with very high market shares, from which for 22 routes the merger would create a monopoly. In addition, the EC found that there were a number of important entry barriers to operating flights from or to Dublin in competition with Ryanair/Aer Lingus, resulted from the well-established position at their home base. On the basis of the EC findings, Ryanair proposed the set of commitments in order to remedy the identified significant impediment to effective competition. The most interesting part is the slot related commitments where Ryanair offered to make available slots for the London-Heathrow route, in total 24-40 Dublin–Heathrow slots per day. Those slots would be exclusively reserved for British Airways and Air France (equally divided between them). Ryanair also committed to make available 4-8 slots for other overlap routes from and to Dublin, as well as a number of slots from/to Shannon and Cork airports. There were additional commitments related to operational concerns of the merged airline, such as the commitment not to increase the frequencies of any of the claimed overlap routes, to reduce Aer Lingus' short-haul fares by at least 10% immediately, to eliminate the fuel surcharges Aer Lingus applies on its long-haul flights immediately, to retain Aer Lingus' brand and to continue to operate Ryanair and Aer Lingus separately. Nevertheless, the EC concluded that: "*those commitments are not sufficient to remedy the identified significant impediment to effective competition and, thus, cannot render the proposed concentration compatible with the common market",* (Case No COMP/M.4439, 2007).

In 2011, the EC received another merger proposition from two Greek airlines, Olympic and Aegean Airlines. Again, both airlines served from the same home base airport in Athens that resulted in a high number of overlapped routes. In its report, the EC noted that together the two carriers control more than 90% of the Greek domestic air transport market, which would discourage any new airline to enter the Greek market after the merger. In spite of the openhanded proposal by the merger parties in which they committed to make available a number of slots at Greek airports, the EC prohibited this concentration with the explanation that Greek airports do not suffer from the congestion, (Case No COMP/M.5830, 2011).

However, in 2013 the EC reconsidered the Greek merger case and after the investigation into the proposed acquisition of Olympic by Aegean Airlines, approved it. In spite of the EC concerns that the proposed transaction raised serious competition concerns on a number of Greek domestic routes, the EC explained that Olympic Air would be forced to exit the market in the near future due to financial difficulties if not acquired by Aegean. Either way Aegean would become the dominant airline on all the affected routes, (Case No COMP/M.6796, 2013).

Another takeover attempt by Ryanair on Aer Lingus occurred in 2009 but they withdrew the proposal. In 2012 they had their last attempt, but a year later the EC refused again their proposition with the justification that it would significantly impede effective competition on the market by creating a monopoly or a dominant position on 46 routes where, currently, Aer Lingus and Ryanair compete against each other.As a part of the proposal, Ryanair offered set of commitments in order to overcome the EC concerns, such as the transfer to Flybe of a number of assets such as cash of EUR 100 million, a lease for at least 9 Airbus A320 aircraft, airport slots (at origin and destination), a royalty-free, non-sub-licensable, non-exclusive and non-transferable license to the Aer Lingus trademark for 3 years, personnel, contracts, real estate etc. In addition, Ryanair offered to the cession of slots to IAG/British Airways at London airports, so that IAG/British Airways would operate on 3 routes (Dublin-London, Shannon-London, and Cork-London). However, the EC decided that these remedies do not address the competition concerns and were insufficient to ensure that customers would not be harmed on the relevant routes, (Case No COMP/M.6663, 2013).

3. DISCUSION

The examination of the mergers under the EC jurisdiction raises some interesting questions, for example, what were the remedies applied in the cases when a merger is conditionally accepted by the EC and what were the proposed remedies in the cases when the mergeris prohibited. In other words, was the EC consistent in assessing the remedies in both cases?What is in common for all prohibited proposals is the fact that those consolidations were initiated by airlines (two airlines in each case) that are well established, both coming from the same countries and using the same home base airport. This fact, per se, can lead to a result in a high market power and a high number of the overlapping routes. This is not in question. What could be in question is how the EC defined the relevant market in the cases when the parties do not have the same home base airport, but their home base airports are relatively close (e.g. Air France-KLM, Lufthansa-Swiss, Lufthansa-Brussels Airlines, etc.). Precisely, the EC conclusion in the Air France-KLM case was that the airlines' networks are largely complementary and that the new entity will not jeopardize the competition in the market. This is certainly the truth when the short-haul flight are considered, but the problem may arise on the mid and long-haul flights, where passengers are less sensitive to the travel time, and direct and indirect flight can be considered as substitutes. It is worth noting that in a time when the merger between these two airlines happens, they were Europe's second and fourth largest airlines with two major international hubs. The problem here was not whether to allow the two airlines to enter into a merger, but was the remedies agreed in this case adequately, due to the increased market power of the new airline. This question could be put in another way, if these remedies were enough in the case when two major European airlines merged, why the set of commitments offered by Ryanair were insufficient, having in mind that the commitments, inter alia, included a number of high-valued Heathrow slots.

Another interesting observation from the analysis is that in British Airways-Iberia case, when the merger is approved without any conditions. Again, both were the leading airlines in their countries with strong route networks inside and outside the EU market. In addition, British Airways and Iberia have been already members of the Oneworld alliance whereby they work together and linked up a substantial part of their networks and this was taken as a base for the EC investigation. According to the EC report no competition concernsare identified from theinvestigation of the overlaps of their networks for the post-merger structure. However, if one analyzes the situation on the routes between the UK and Spain, in particular between London and Madrid airports in the summer season 2009 the result may raise some doubts about the EC judgment. Namely, the parties operated the route from London airports to Madrid with altogether 15 daily frequencies, while all competitors (Easyjet, Air Europa and Ryanair) operated with 7 daily frequencies, (Case No COMP/M.5747, 2010). Based on daily frequency, the parties' market share is more than 60% and this result may indicate the market dominance on the route London-Madrid. In the EC report, the parties argued that the merger will not change the competitive structure on the route London-Madrid, which is true, having in mind that the effects of a merger are normally assessed on the basis of the pre-merger situation when they were already allowed to operate as an alliance with the dominant position. This raises another important question:is the competition concerns addressed by the EC only related to a problem caused by the merger and how to deal with the markets where the pre-merger structure was not competitive in the first place?

Finally, the case that has attracted much public attention, Aegean Airlines' acquisition of Olympic, raises some doubts about the EC decisions of approved or rejected mergers that are not based only on legal attributes, but also succumbed to the political and economic influence. In this particular case the problem is in the EC explanation of the approval, that otherwise Olympic would be forced to exit the market in the near future due to financial difficulties if it were not acquired by the Aegean. With this attitude the EC rejected the possibility that a new competitor might entry on the routes once the Olympic withdrew. Another important issue in this case is in the fact that on the domestic market Aegean and Olympic jointly control 90% of seats, which inevitably leads to monopoly (Economist, 2014).

4. CONCLUSION

While it is still not easy to establish what has been the impact of air transport liberalization policies on economic growth and traffic in general, it is clear that mergers play important role in restructuring the transport market in line with demand for higher efficiency and effectiveness of the service providers. EU has a legitimate interest to secure the environment that offers customers goods and services at most favorable terms. The EC has extensive competences in this respect, so it is very important that criteria for allowing (conditionally or unconditionally) mergers are transparent and consistently applied. The EC's assessment of the relevant geographic and product market has to be persuasively justified, based on solid evidence and deep market impact analysis, while the proposed remedies must be in the service of the promotion of competition, and not unfair treatment for one of the sides involved.

It is evident that there are some restrictions which slow down the unavoidable process of consolidation. Although the deregulation and liberalization processes have advanced, the EU market is still characterized by a large number of national airlines and strong influence of the governments, which makes mergers more complicated, and the role of the EC still very sensitive.

ACKNOWLEDGEMENT

This research has been supported by the Ministry of Education, Science and Technological Development, Republic of Serbia, as a part of the project TR36033 (2011-2016) and the project 179076 (2011-2016).

REFERENCES

Begović, B., & Pavić, V., (2010). *Šta je to konkurencija i kako se štiti?* Belgrade, Serbia: Center for Liberal-Democratic studies, 30.

Economist (2014), *Aegean stable*. Retrieved from http://www.economist.com/blogs/gulliver/2014/06/greek-aviation

Iatrou, K., & Oretti, M. (2007). *Airline Choices for the Future: from Alliances to Mergers.* Hampshire, England: Ashgate Publishing Limited.

Kociubinski, J., *Consolidation or Fragmentation? European Competition Law in the EU Air Transport Sector: A Policy Analysis,* Polish Yearbook of International Law, XXIII, Polish Academy of Science (2013).

Merger Procedure (2004). Case No COMP/M.3280 - Air France / KLM. Retrieved from http://ec.europa.eu/competition/mergers/cases/decisions/m3280_en.pdf

Merger Procedure (2005). Case No COMP/M.3770 - Lufthansa/Swiss. Retrieved from http://ec.europa.eu/competition/mergers/cases/decisions/m3770_20050704_20212_en.pdf

Merger Procedure (2005). Case No COMP/M.3940 Lufthansa/Eurowings. Retrieved from http://ec.europa.eu/competition/mergers/cases/decisions/m3940_20051222_20212_de.pdf

Merger Procedure (2007). Case No COMP/M.4439 – Ryanair/Aer Lingus. Retrieved fromhttp://ec.europa.eu/competition/mergers/cases/decisions/m4439_20070627_20610_en.pdf

Merger Procedure (2009). Case No COMP/M.5364–Iberia/Clickair/Vueling. Retrieved from http://ec.europa.eu/competition/mergers/cases/decisions/m5364_20090109_20212_en.pdf

Merger Procedure (2009). Case No COMP/M.5335 - Lufthansa/ SN Airholding. Retrieved from http://ec.europa.eu/competition/mergers/cases/decisions/M5335_20090622_20600_229007_EN.pdf

Merger Procedure (2009). Case No COMP/M.5440–Lufthansa/ Austrian Airlines. Retrieved fromhttp://ec.europa.eu/competition/mergers/cases/decisions/m5440_20090828_20600_en.pdf

Merger Procedure (2010). Case No COMP/M.5747–Iberia/British Airways. Retrieved from http://ec.europa.eu/competition/mergers/cases/decisions/M5747_20100714_20310_802534_EN.pdf

Merger Procedure (2011). Case No COMP/M.5830–Olympic/Aegean Airlines. Retrieved from http://ec.europa.eu/competition/mergers/cases/decisions/m5830_7897_2.pdf

Merger Procedure (2012). Case No COMP/M.6447-IAG/BMI. Retrieved from http://ec.europa.eu/competition/mergers/cases/decisions/m6447_20120330_20212_2452290_EN.pdf
Merger Procedure (2013). Case No COMP/M.6607–American Airlines/US Airways. Retrieved from http://ec.europa.eu/competition/mergers/cases/decisions/m6607_20130805_20212_3206867_EN.pdf
Merger Procedure (2013). Case No COMP/M.6663–Ryanair/Aer Lingus III. Retrieved from http://ec.europa.eu/competition/mergers/cases/decisions/m6663_9077_1.pdf
Merger Procedure (2013). Case No COMP/M.6796-Aegean/Olympic II. Retrieved from http://ec.europa.eu/competition/mergers/cases/decisions/m6796_20131009_20682_4044023_EN.pdf
Merger Procedure (2014). Case No COMP/M. 7333–Alitalia/Etihad. Retrieved from http://ec.europa.eu/competition/mergers/cases/decisions/m7333_20141114_20212_4015913_EN.pdf
Merger Procedure (2015). Case No COMP/M.7541–IAG/Aer Lingus. Retrieved from http://ec.europa.eu/competition/mergers/cases/decisions/m7541_20150714_20212_4564413_EN.pdf
Cases:
ECJ, *United Brands v. Commission,* C 27/76 (1976)
CJEU, *Hoffman-La Roche v. Commission,* case 85/76 (1979)

THE UPRISE OF THE MIDDLE EAST CARRIERS – EMIRATES' PATH TOWARDS SUCCESS

Jovana Kuljanin*[1], Milica Kalić[1]
[1]University of Belgrade – Faculty of Transport and Traffic Engineering
* Corresponding author, e-mail: j.kuljanin@sf.bg.ac.rs

Abstract: *Aviation sector plays a prominent role in the era of rising economy of the Middle East. In the last two decades, major oil-producing countries have established their own national carriers that brought significant changes and posed a burden of challenge to their competitors, especially those that operate long-haul traffic. The paper provides a brief overview of "state-of-the-art" literature on three "emerging airlines" such as Emirates, Qatar Airways and Etihad Airways which see tremendous expansion and permanently alter traffic flows across the globe. It also underlines the Emirates' competitive advantage gained throughout implementation of hourglass network and efficient cost structure supported by the economic and social development of the Dubai Emirate.*

Keywords*: emerging carriers, Emirates, the Middle East, hourglass hub, cost structure*

1. INTRODUCTION

The region of Middle East has historically been attractive as an inevitable point on trade routes between Europe and the Far East. The archaeological documentation reports that established trade routes connecting Europe to the Far East passed through the Arabian Peninsula even 3500 years ago. Despite political and ethical unrest combined with persistent tension between different nations over decades, this region remains the important "connector" that stands on the shortest path between the East and the West in modern times.

According to AEA (2006) the 'Middle East' includes 13 countries[1], located in an area which stretches east of the Mediterranean, south to the Arabian Peninsula and north to the Caspian Sea covering a total land area of 5 million square kilometers. Within this region, the Gulf Cooperation Council (GCC) stands out as a separate sub-regional group encompassing major oil producing countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates) which intend to create free cross-border investments and trade in services. The economic emergence of the region dated back to the period from 1965 to 1985 facilitated by dramatic rise in oil prices. Oil producing countries (especially large producers such as Saudi Arabia, Iran, Iraq, Kuwait) benefited directly in the form of high export earnings (Global Perspectives, 2000). In order to reduce their reliance upon oil production in the future, many countries diversify their economies and make significant effort to further develop sectors such as financing, tourism, light manufacturing and agriculture. Aviation is certainly seen as a contributor that can boost a bunch of services within tertiary sector such as tourism, hosting of international conferences and trade shows, opening luxurious corporate headquarters, etc. Therefore, the regional governments are strongly promoting the aviation sector, carrying out destination-marketing campaigns and ensuring the presence of the country at major international Travel and Transportation fairs (Vespermann et al., 2008).

In the last two decades, the role of the region has experienced tremendous transformation from the technical intermediate point for aircraft with limited range to the leading region in terms of trade and travel flows. Hooper et al. (2011) argue that this transformation represents a "principal axis shift" towards a fundamentally changed global aviation network built upon the economic and social development within the region. Arabian Gulf-based airlines, viz. Emirates, Etihad Airways and Qatar Airways, are among the fastest growing full service airlines in the world with their hubs located in Dubai, Abu Dhabi and Doha. These carriers are often called "emerging carriers", the term used in the late 2000s to describe the group of carriers based in the Middle East that were growing rapidly (Al-Sayeh, 2014). Although this term has not been precisely defined, it often refers to carriers which have remarkable growth in annual number of passengers, capacity and fleet and operate long-haul flights from their respective hubs.Therefore, Emirates, Etihad Airways and Qatar Airways represent this group adequately.

[1]Bahrain, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, the United Arab Emirates and Yemen

Emirates is certainly the largest carrier having aggressive expansion at phenomenal average annual pace of 12.4% in the number of passengers in the last five years (from 27.5 mil. in 2010 to 49.3 mil. in 2015). Unlike the other two carriers which cooperate closely with other carries through their membership in alliances, Emirates is still not that receptive to partnership. This carrier is considered as a "game changer" in airline industry as it brings conceptual changes and innovations in business model supported by Dubai's rapid expansion. The purpose of this paper is to reveal the key competitive advantage of Emirates over its rivals, especially those of the similar size in Europe. Thus, this paper outlines the most important findings from the current "state-of-the-art" literature (the papers in relevant journals and publications) that investigate the rising activities of several "emerging" airlines in the Middle East. Section 2 provides the most important information about the three emerging carriers. Section 3 focuses on the business model of Emirates with its distinctive characteristics which assure competitive advantage and pose a challenge to other carriers on the market. This section analyses in details the cost structure as the most important advantage which contribute to Emirates' favourable position on the market, by relying on the data provided in its annual reports. Finally, Section 4 concludes the paper.

2. OVERVIEW OF EMERGING CARRIERS' DEVELOPMENT

Gulf Air is the ancestor of today's most prosperous airlines in the Middle East: Emirates, Etihad Airways, Qatar Airways and Oman Air. The airline was founded in 1974 by the governments of Bahrain, Qatar, the UAE and Oman who purchased the company from the British Overseas Airways Corporation and later transformed it into Gulf Air. The newly formed carrier was the mutual national carrier of the four mentioned countries and had its base at Bahrain International Airport, mainly servicing flights to Europe and the Far East. In the early 1980s, Gulf Air rapidly enlarged its network,requiring new airplanes to be acquired. At that time, Gulf Air focused its operation primarily out of its hub in Bahrain, while the number of weekly flights to Dubai was reduced from 108 to 41 in mid-1983 (Hooper et al., 2011). Ambitious plan of Sheikh Mohammed bin Rashid Al Maktoum, the current ruler of Dubai and the Prime Minister of the UAE, was to "breathe new and modern life" into Dubai by developing an air transportation system as a backbone of economic activities. Thus, the state invested a modest sum of 10 million USD and leased two aircraft in order to launch its own airline – and Emirates was born in October 1985. At the beginning of its operation, the company had only a single route to Karachi. The growth of Emirates tremendously affected the growth of Dubai Airport that had merely 3 million passengers prior to and at the beginning of Emirates' emergence. CAPA (2015a) reported that passenger numbers at Dubai had grown to 12.3 million by 2000, with over 1.2 million transit passengers shuttling via the rapidly growing hub. In 2014, Dubai airport counted over 70 million passengers, two thirds flying Emirates.

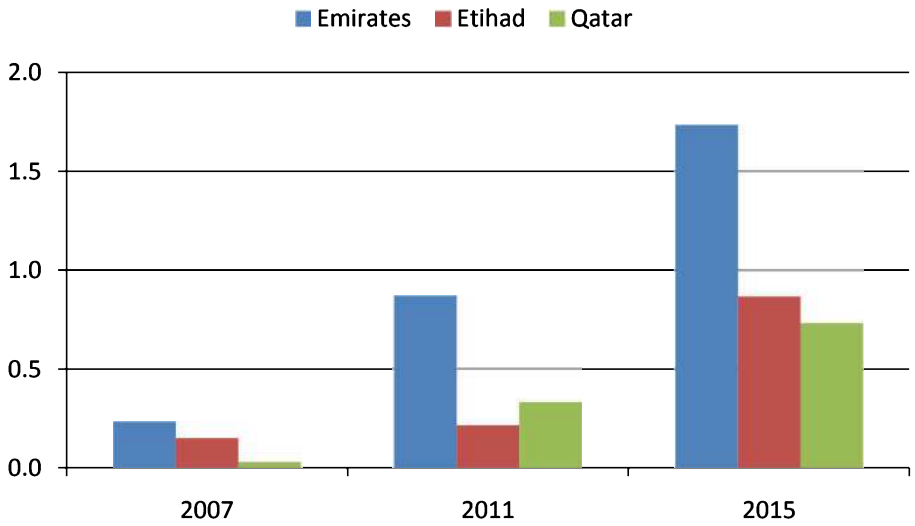


Figure 1: Emirates, Etihad and Qatar Airways seats into the US: 2007, 2011 and 2015 (in millions)

Shortly after foundation of Emirates, the neighbouring countries came up with ambitious plans to establish their own national carriers that reflected the status symbol of power and sovereignty. Oman and Qatar formed their own national carriers which allowed them to be less dependent upon Gulf Air services, although they continued to fund Gulf Air. In order to concentrate their effort solely on its own national carrier, Qatar decided to withdraw from Gulf Air in 2002, followed by Oman in 2007. Finally, in 2003 the UAE founded its own national career, Etihad Airways, and subsequently withdraw from Gulf Air. In such newly circumstances,

Bahrain remained the only country stakeholder in Gulf Air, which severely exacerbated its position on the highly competitive market. The expansion of these three airlines can be evidently observed by the increasing number of seats offered in 2007, 2011 and 2015, as depicted in Fig.1. On the other hand, Gulf Air currently offers flights within the Middle East and still provides flights to major European hubs as well as Bangkok. The short overview of the emerging carriers will be given in next sub-sections in reverse chronological order beginning with most recently founded airline, Etihad Airways and ending with the most successful one among them – Emirates.

2.1. Etihad Airways

Etihad Airways is the national carrier of the Emirate of Abu Dhabi with its base at Abu Dhabi International Airport. This carrier has both narrow and wide-body Airbus and Boeing aircraft in the fleet servicing a rapidly expanding network within the Middle East and to Europe, Asia, North America, Canada and Australia (CAPA, 2016a). Beirut was the company's first destination to offer from its base in Abu Dhabi in November 2003, adding the new destinations almost every month. The order of 29 Boeing and Airbus aircraft shortly after its set-up represents the largest ever commercial airline start-up order. Passengers carried accounted for 4.6 million in 2007, continually recording rapid growth by an average rate of 18% in the following 8 years (2008 - 2015).

Etihad highly relies on codeshare agreement as a common tool that could significantly bolster passenger demand. Since its first codeshare with American Airlines in 2009, Etihad signed over 40 codeshare agreements with some of the worlds' largest airlines such as Air France, Air Canada and Turkish Airlines, placing itselfin the first place by the number of ratified agreement. Moreover, after being rejected from global alliances, Etihad started establishing its own partnership platform by acquiring equity stake in other airlines. Until now, Etihad owns equity stakes in seven airlines that range from 3% in Air Berlin to 49% in former Jat Airways (now rebranded into Air Serbia). According to CAPA (2016a), Etihad Partners will have only about 2.6% of global ASKs compared to 18% to 24% each for the three big alliances, but it will serve half as many countries as the main alliances (almost 250 destinations in 80 countries). Unlike major alliances which mainly focus on revenue synergies, Etihad equity alliance tackles both revenue and cost structure side, describing "partnership" not as an alliance, but a "brand" (CAPA, 2014a). Thus, Etihad's goal is to achieve the quality of a membership which relies on standardizing the products across the various airlines.

The growth in passenger demand continued to surpass the airline's capacity increase which boosted the need for further fleet expansion (Arabian Business, 2016). In 2015, Etihad Airways' fleet was boosted by the deployment of the Boeing 787-9 Dreamliner, which entered commercial service on routes to Washington DC, Zurich, Singapore and Brisbane.

2.2. Qatar Airways

Qatar Airways was established in 1993 offering its flights to destinations within the GCC and the Middle East. The aim of Qatari Royal family was to transform the airline with only three wide-body and one narrow body aircraft into a strong long-haul international airline. Therefore, the aggressive expansion plan was adopted which assumed acquisition of new aircraft types in order to expand the network. At the 2005 Paris Air Show, Qatar Airways placed an order for 60 Airbus and 20 Boeing 777s, with options for 20 more. Subsequent orders were placed in 2006 and again in 2007 for additional Boeing B777s and for eighty A350 aircraft valued at over 16 billion USD (Hooper, 2011). Main network carriers around the globe carefully observed such intensive fleet enlargements which could potentially jeopardize their position on specific markets. Meanwhile, Qatar Airways showed its willingness to join Oneworld alliance as Emirates kept on putting competitive pressure on many routes due to significantly greater seat capacity and network size. In October 2013, Qatar became a member of Oneworld hereby allowing its passengers greater number of destinations. After accession into the Oneworld, Doha Airport grew into the first alliance hub in the Arabian Gulf. The new airport in Doha was opened on April 2014 and was designed specifically to accommodate A380, since Qatar Airways may order additional units in the future (by 2020, the fleet will contain 10 aircraft type A380).

2.3. Emirates

When Emirates was founded in 1985 by Sheikh Mohammed and his uncle Sheikh Ahmed, it had only two Boeing 727-200s and a start-up capital of 10 million USD as a gift from its founders. In the early period of its business, the company endeavored to build its network in the Middle East and the Indian Subcontinent. The first purchased aircraft was received in 1987 when Emirates started offering its flights to London Gatwick and Frankfurt. In the period from 1990s to 2000s, the airline was relatively unknown in the aviation world until

making the stunning 15 million USD wide-body aircraft order. Since then, the company gradually expanded its fleet by introducing only wide-body aircraft and recently became the largest customer and operator of the Airbus A380 and Boeing 777, with 44 and 121 aircraft respectively. For example, Emirates' fleet is larger than Singapore Airlines and Virgin Atlantic' fleets combined, and these airlines employ onlywide-body fleet (Al-Sayeh, 2014). Concerning the configuration of its wide-body aircraft, Emirates placed into service its latest A380 two-class version seating with 615 seats, which means 18% more seats than its densest A380 configuration (519 seats) (CAPA, 2015b).

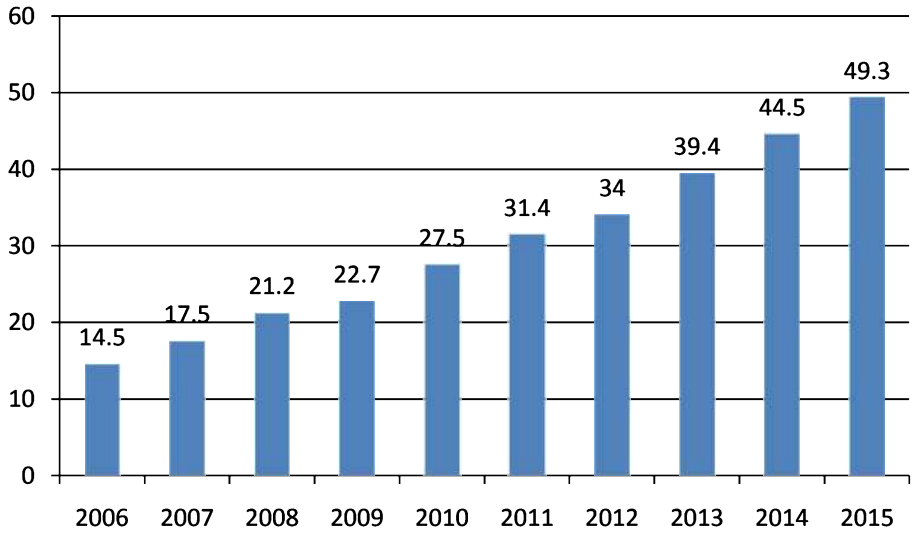


Figure 2: Emirates' number of passengers (2006-2015) (in millions)

Nowadays, Emirates is one of the leading airlines in the world and is expected to surpass even the biggest players such as Delta, United and American, in terms fleet and passenger's growth by the end of 2020. Fig. 2 shows the evident growth in the number of passengers from 2006 to 2015 which almost quadrupled during this period. Emirates' partnership was relatively limited in scope and quantity (CAPA, 2016b) which was not characteristic of other large carriers as they extensively used the benefits of codeshare agreements to gain more passengers and decrease their costs. Emirates and Qantas ratified the agreement announced in 2012 which enabled Qantas to operate through Dubai hub as a connecting airport for Qantas' passengers on their way to Europe. Such cooperation would contribute to considerable advantages, such as revenue sharing and extensive codesharing from both parties on overlapping markets, as well as behind and beyond gateways. Since recently, Emirates is becoming more receptive to those partners with whom reasonable value could be additionally extracted. Thus, the partnership with TAAG in Angola is certainly the smallest, while that with Malaysia Airlines is the larger one.

3. AN OVERVIEW OF EMIRATES' KEY COMPETITIVE ADVANTAGE

As mentioned above, Emirates as well as other airlines from the Middle East, has been absolutely marginal in terms of competition for the large carriers from Europe, America and Asia for a long time. With its aggressive expansion in fleet supported by economic rise of the region in the last decade, especially the Emirate of Dubai, Emirates became a serious threat to long-haul carriers diverting a large portion of passengers to its flights via Dubai Airport. Dubai Airport, as well as other "emerging" carriers' hubs in the Middle East, has a very favorable position since 4.5 billion people reside within an 8-hour flight of the Middle East, providing the potential for a large part of the world's population to connect through a single stop (O'Connell, 2011). The proximity of Asia which is home to more than half of the planet's population emphasizes the potentials of the emerging carriers.

Unlike large European legacy carriers, which implies a hub-and-spoke network in which short/medium-haul flights and long-haul intercontinental flights feed each other through a hinterland hub, Emirates derives substantial cost savings by forming an hourglass hub in which long-haul intercontinental flights and long-haul intercontinental flight feed each other. For example, Air France-KLM report EUR 100 million losses due to Air France regional network in 2012 (CAPA, 2013a), while Lufthansa losses in short/medium haul non-hub network may account to EUR 200 million (CAPA, 2013b). Emirates focuses its business on "secondary-hub-secondary" strategy of connecting Europe's secondary airports with cities in Asia and Australia with only one transfer enabling them to enjoy a competitive advantage in travel time on a number of city pairs because

legacy carriers offer itineraries with two transfers; "secondary-hub-hub-secondary" (Grimme, 2011). Such a network structure provides benefits for passengers' convenience by reducing the number of required connections – Glasgow-Dubai-Sydney with Emirates has one leg less than Glasgow-London-Singapore-Sydney with British Airways). Thus, Emirates offers its flights from secondary airports in Europe (Birmingham, Manchester, Newcastle, Nice, Venice, Düsseldorf and Hamburg) to Asia-Pacific region. From a theoretical point of view, Emirates designed the new concept of expanding its network by adding new "alternative" routes ("edges") rather than byintegrating additional airports ("nodes") into the network. However, choosing hourglass network does not necessarily ensure shorter travel time between certain regions. Vispermann (2008) argues that Emirates, as well as other emerging carriers, have geographic advantage (and consequently, shorter travel time) in regard to South Asia and Oceania, while European carriers offer flights with shorter travel time to destination in North Asia. Emirates is also ideally positioned for India, the second most populous country, for its travel to North America, Europe and Africa (de Wit, 2014) which is not surprising having in mind that India is in the first place by the seat capacity offered in 2016 (Fig. 3).

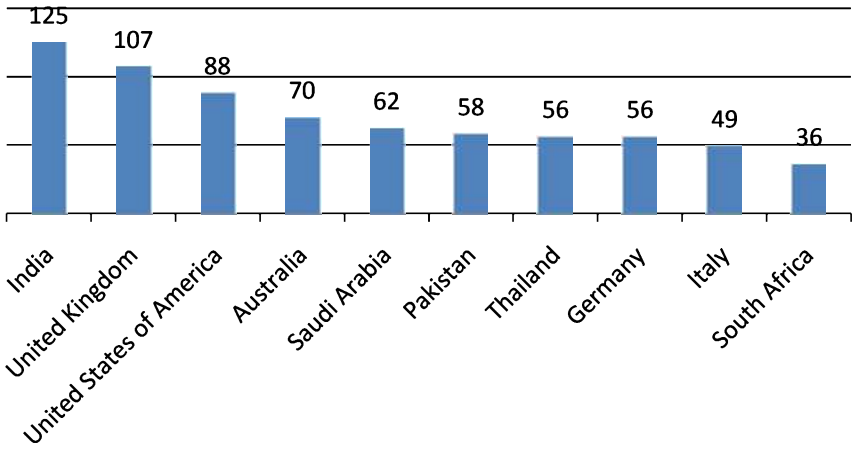


Figure 3: Emirates' seat capacity by country (28-Dec-2015 to 3-Jan-2016) (in thousands)

Likewise in any other industry, keeping unit cost as lower as possible is essential in gaining competitive advantage since it allows airlines to be profitable at low fares. However, when comparing unit costs one must have in mind that they vary according to the average trip length. In general, the cost of producing a seat-kilometre (CASK) falls as average sector length increases since fixed costs are amortized over more seat-kms, while variable costs, such as fuel, are more efficiently consumed in longer flights (CAPA, 2014b).

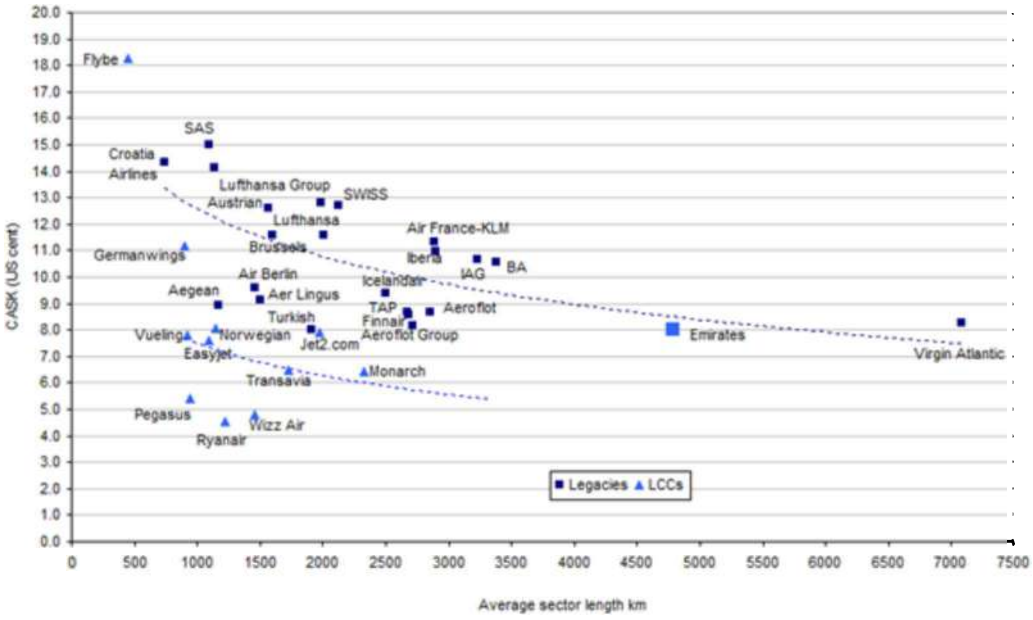


Figure 4: Cost per ASK, CASK, (UScent) and average trip length for selected European legacy and low-cost carriers and Emirates in 2012

Operating hourglass network enables reduction of costs per seat-kilometer as aircraft size increases and reduction of operational costs per kilometer as stage length increases. In other words, only the differences in network structure and design (hourglass hub *vs* hinterland hub) can lead to significant cost differences and competitive advantage to a carrier which operates hourglass network. As it can be observed from Fig. 4, Emirates' CASK is below major European carriers' trend line, as well as below Virgin Atlantic that also relies its operation on ultra long-haul traffic.

A great number of legacy carriers in Europe, supported by their governments, have complained against Emirates' expansion at respective airports. Therefore, many protectionist measures have been stipulated such as those by the German Federal Office for Goods Transport that forced Emirates to increase the price of its business-class fares by about 20% in 2009.

In order to understand Emirates' competitive advantage over its rivals, especially those in Europe and North America, it is crucial to look into airlines' cost structure (Fig. 5).

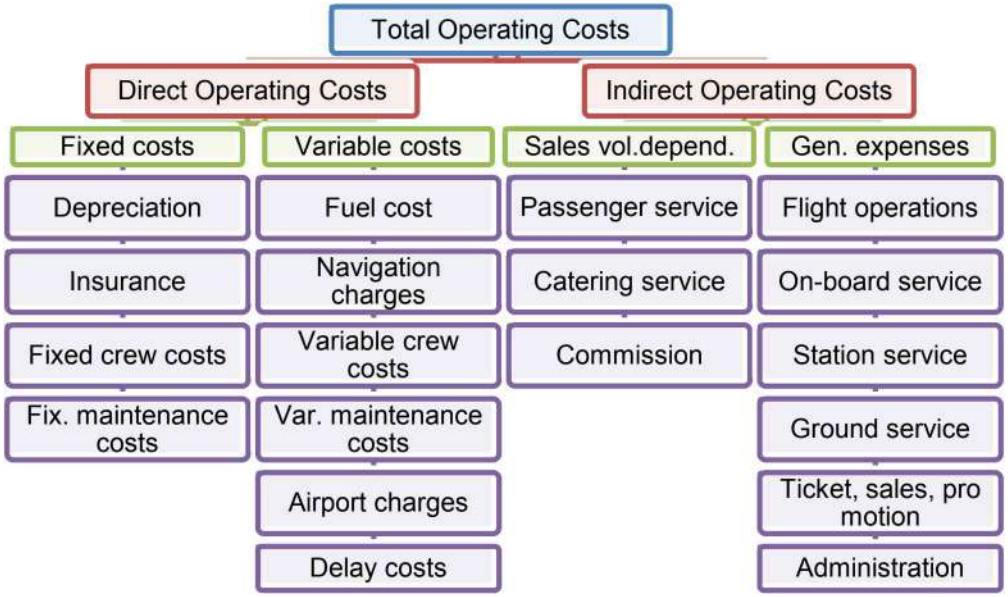


Figure 5: Airline operating costs

Direct operating costs are all those expenses associated with and dependent on the type of aircraft being operated, including all flight expenses (flight crew salaries, fuel, airport and navigation charges), all maintenance and overhaul costs, and all aircraft depreciation expenses. Indirect operating costs are all those costs that will remain unaffected by a change of aircraft type because they are not directly dependent on aircraft operations, including expenses that are passenger-related rather than aircraft-related (such as passenger service costs, costs of ticketing and sales, and station and ground costs), and general and administrative costs. (Wensveen, 2007).

In order to be consistent in unit cost comparison, the airlines' average trip length should be of the similar size. For this reason, in its analyses, CAPA (2014b) compares Emirates' unit costs by cost category with the average unit cost of IAG[2] and Virgin Atlantic, since the average trip length of the latter two approximates to the average trip length of the former.

The results presented in Fig. 6 show that Emirates has an advantage in almost every cost category (labor, fuel, maintenance, landing, parking, overflying, handling, catering, corporate overheads) except selling costs and aircraft ownership costs (depreciation, amortization and operating leases). It is evident that Emirates' gains the most significant savings in three cost categories – labor, fuel and maintenance.

Lower unit labor costs come from the practice of hiring workers from South and South East Asia entwined with Emirates' ban on unionization. Emirates' advantage in fuel cost per ATK comes from the greater fuel efficiency of its young fleet, which has more seats and fuel-efficient engines. The young fleet comprising modern aircraft further contributes to lower maintenance costs. Finally, the "landing, parking and overflying" charges are much lower in Dubai Airport from which a large portion of Emirates' flights have been operated.

[2]IAG – the holding company of Aer Lingus, British Airways, Iberia and Vueling

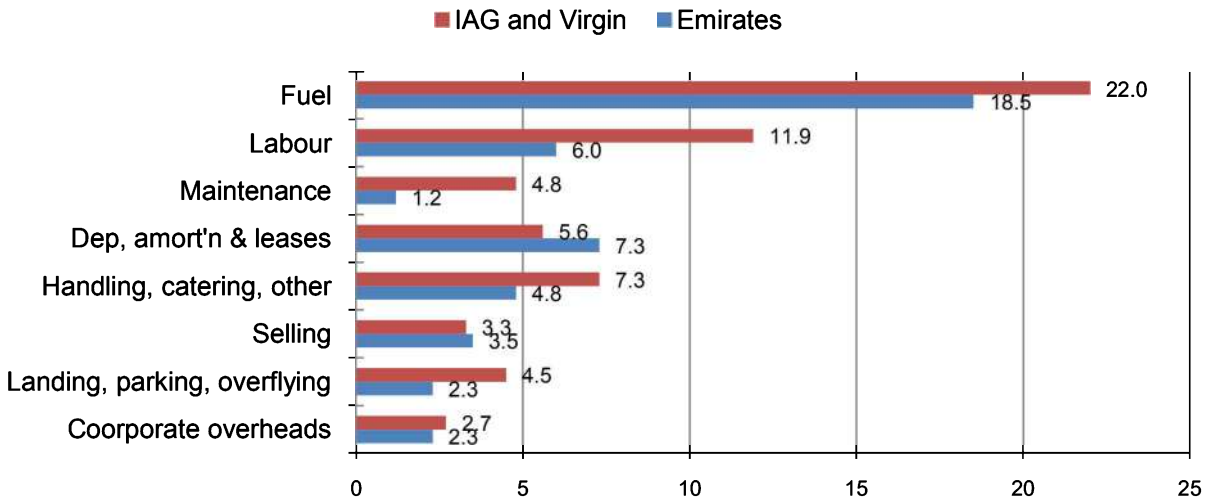


Figure 6: Cost per available tonnekilometre (USc) by cost category for Emirates versus the average of IAG and Virgin Atlantic in 2012

Higher costs per ATK (available tonnekilometres comprises both cargo and passengers) in aircraft ownership category result from huge investments in purchasing new aircraft and significant use of operating leases. In comparison to Lufthansa which has 622 aircraft, out of which a hefty share of 90% is owned (only 4% are on an operating lease and another 6% are on finance leases), Emirates has 205 aircraft, 7% of what are owned, 57% are on are on operating leases and another 36% are finance leased. However, these higher costs are further compensated by lower maintenance cost. The higher unit cost per ATK in "Commercial and selling costs" comes from extensive promotional expenditure such as sponsorship of big sport events as well as from the use of indirect distributional channels in catchment areas such as India and Africa.

4. CONCLUSION

Located at the crossroads between Asia, Africa, and Europe, the region of the Middle East has traditionally been an inevitable point on the routes connecting these regions. The most prosperous countries of the Middle East (i.e. oil-producing) invested substantially in the aviation sector in the last two decades as a part of their intensions to diversify their respective economies in post-oil era. Shortly after their establishment, the "emerging" carriers (Emirates, Qatar Airways and Etihad Airlines) started to benefit from both geographical positions, cost structure which allows tremendous savings in many cost categories and additionally generated demand for air travel. Their favorable geographical position enables approximately 80% of the world population to travel within an eight-hour flight of the region. The "emerging" carriers have broadly exploited this advantage by aggregating traffic at their hubs and offering the shortest one-stop service between many distant city pairs in the East and the West. The long-haul hourglass network developed in this way completely derives the benefits which stem from technological economies of scale of a modern long-haul wide-body fleet.

The largest and most profitable among them, Emirates, is completely owned by the government of Dubai which enables it to operate in a tax free environment with no legacy cost. The successful growth that the airline recorded over the last two decades lies in several important facts such as: flat management model adopted (organizational structure with few or no levels of middle management between staff and executives), avoiding direct subsidies and embracing the competition forced onto it by Dubai's liberal aviation policies. The paper emphasizes the importance of Emirates' hourglass network via its Dubai hub which brings significant savings as the cost of producing a seat-kilometre (CASK) falls as average sector length increases. The results of unit cost across operating costs indicate that the airline gains significant savings in the cost categories such as labor, fuel and maintenance. On the other hand, selling costs and aircraft ownership costs are the only two categories where Emirates has higher unit costs compared to its competitors with similar characteristics. In this way, it can be concluded that the "emerging carriers" has permanently altered the current outlook of aviation industry and caused legacy carriers, especially those from Europe and the United States, to revise their business in order to sustain profitable growth in the future.

REFERENCES

Al-Sayeh, K. (2014). The Rise of the Emerging Middle East Carriers: Outlook and Implications for the Global Airline Industry. MSc thesis in Transportation at the Massachusetts Institute of Technology

Arabian Business. (2016). Etihad Airways sees passenger numbers grow 17% in 2015. Retrieved from: http://www.arabianbusiness.com/etihad-airways-sees-passenger-numbers-grow-17-in-2015-618309.html

Association of European Airlines (AEA).(2006). Blueprint Middle East. Market Research Quarterly, (3)

CAPA – Centre for Aviation. (2013a). World Aviation Yearbook 2013, Europe.CAPA Centre for Aviation, Sydney, Australia.

CAPA – Centre for Aviation. (2013b). Germanwings Rebrands: You Say You Want a Revolution? to Be Led by Cost and Operations. CAPA Centre for Aviation, Sydney, Australia. Retrieved from: http://centreforaviation.com/analysis/germanwings-rebrands-you-say-you-want-a-revolution-to-be-led-by-cost-and-operations-104001

CAPA – Centre for Aviation. (2014a). "Etihad Airways Partners" Alliance accounts for 2.6% of global ASKs, 2.0% of seats.Retrieved from: http://centreforaviation.com/analysis/etihad-airways-launches-partners-alliance-with-26-of-global-asks-20-of-seats-191467

CAPA – Centre for Aviation. (2014b). Unit cost analysis of Emirates, IAG & Virgin; about learning from a new model, not unpicking it. Retrieved from: http://centreforaviation.com/analysis/unit-cost-analysis-of-emirates-iag--virgin-about-learning-from-a-new-model-not-unpicking-it-147262

CAPA – Centre for Aviation. (2015a). Emirates Airline turns 30: Just as it has changed the world, now Emirates faces its own changes. Retrieved from: http://centreforaviation.com/analysis/emirates-airline-turns-30-just-as-it-has-changed-the-world-now-emirates-faces-its-own-changes-245140

CAPA – Centre for Aviation. (2015b). A380 fleet profile: Emirates prepares for 615 seat configuration. SIA will dispose of early models. Retrieved from:http://centreforaviation.com/analysis/a380-fleet-profile-emirates-prepares-for-615-seat-configuration-sia-will-dispose-of-early-models-249033

CAPA – Centre for Aviation. (2016a). Etihad Airways.Retrieved from:http://centreforaviation.com/profiles/airlines/etihad-airways-ey

CAPA – Centre for Aviation. (2016b). Emirates Airline: The strategy reshapes in 2016 – partnerships, China growth, smallerwidebodies. Retrieved from:http://centreforaviation.com/analysis/emirates-airline-the-strategy-reshapes-in-2016-partnerships-china-growth-smaller-widebodies-260221

De Wit, J. (2014). Unlevel playing field? Ah yes, you mean protectionism. *Journal of Air Transport Management* 41, 22-29. doi:10.1016/j.jairtraman.2013.11.012

Global Perspectives. (2000). Retrieved from:http://www.cotf.edu/earthinfo/meast/MEeco.html

Grimme, W. (2011). The growth of Arabian airlines from a German perspective – A study of the impacts of new air services to Asia. *Journal of Air Transport Management,17* (6), 333-338. doi:10.1016/j.jairtraman.2011.02.002

Hooper, P., Walker, S., Moore, C., Al Zubaidi, Z. (2011). The development of the Gulf region's air transport networks – The first century. *Journal of Air Transport Management,17* (6), 325-332. doi:10.1016/j.jairtraman.2011.02.001

O'Connell, J. F. (2011). The rise of the Arabian Gulf carriers: An insight into the business model of Emirates Airline. *Journal of Air Transport Management17* (6), 339-346. doi:10.1016/j.jairtraman.2011.02.003

Vespermann, J., Wald, A., Gleich, R. (2008). Aviation growth in the Middle East – impacts on incumbent players and potential strategic reactions. *Journal of Transport Geography16* (6), 388-394. doi:10.1016/j.jtrangeo.2008.04.009

Wensveen, J.G. (2007). *Air Transportation: A Management Perspective* (6th ed.) Hampshire, England: Ashgate

TECHNOLOGY AND INNOVATION MANAGEMENT 1414

TECHNOLOGY STATUS AND COMPETITIVENESS OF SERBIAN MANUFACTURING INDUSTRY 1415
Štrbac Dijana

GLOBAL ELECTRONIC MARKET IN THE FUNCTION OF RETAILERS INTERNATIONALIZATION 1422
Končar Jelena, Petrović Katai Zita, Leković Sonja

THE CONCEPT OF HYBRID METHOD FOR RISK ASSESSMENT IN NEW PRODUCT DEVELOPMENT 1428
Milutinović Radul, Stošić Biljana

INDEX OF POTENTIAL FOR TECHNOLOGY ENTREPRENEURSHIP DEVELOPMENT: PRACTICE FROM SERBIA 1436
Rakićević Jovana, Levi Jakšić Maja, Jovanović Milica

USE OF MODERN TECHNOLOGY IN HOTEL ORGANISATION: THE INFLUENCE OF INFORMATION TECHNOLOGY ON HUMAN FACTOR 1442
Jovanović Olga, Savoiu Gheorghe

POTENTIAL IMPACT OF 3D PRINTING IN REDESIGNING SUPPLY CHAIN - EXAMPLE OF MEDICAL INDUSTRY 1449
Rakić Bogdan, Ratković Aleksandra, Mrvić Jovana

SUPPORTING DEVELOPMENT OF TECHNOLOGICAL STARTUPS THROUGH MENTORING 1457
Okanović Milan, Anđelković Labrović Jelena, Stefanović Tijana

EVALUATION AND SELECTION OF TECHNOLOGY STRATEGIES USING QUANTITATIVE STRATEGIC PLANNING MATRIX 1465
Jevtić Milica, Demirović Ranko, Marinković Sanja

OPPORTUNITIES AND THREATS OF GLOBAL TECHNOLOGY AND OPERATIONS STRATEGY IN OIL AND GAS INDUSTRY 1474
Sekulović Ivan

DEVELOPMENT OF A NEW PROJECT 1483
Mišković Zorana, Milinković Ivana

TECHNOLOGY AND INNOVATION MANAGEMENT

TECHNOLOGY STATUS AND COMPETITIVENESS OF SERBIAN MANUFACTURING INDUSTRY

Dijana Štrbac*[1]
[1]University of Belgrade, Institute Mihajlo Pupin
*e-mail: dijana.strbac@pupin.rs

Abstract: *Manufacturing industry is regarded as a main engine of economic growth. This paper aims to reveal characteristics of manufacturing industry in Serbia in terms of its technology structure, competitiveness and relative position in a group of countries. Technology structure is presented on the basis of OECD classification of industry based on R&D intensity and competitiveness is introduced using Competitive Industrial Performance (CIP) index as an indicator of relative competitive ability. Conducted analysis has shown that Serbian manufacturing industry is lagging behind selected EU countries which has negative impact on economic growth and development.*

Keywords*: industry, manufacturing industry, technology structure, competitiveness, Competitive Industrial Performance (CIP) index.*

1. INTRODUCTION

Since the first industrial revolution, over the second and third, until the emerging fourth industrial revolution, industry is the main driving force of economic growth and development. This driving force is an integral part of the process of diversification and development of human creativity and its needs, and it depended on technological progress and the dynamics of the development of knowledge, science and technology. The development features and characteristics are based on the development and structural changes of the industry, which includes relative participation of new and technology intensive industries. There are theoretical and empirical arguments proving that the industry, especially the manufacturing sector, is the initiator and driving force of economic development and structural changes of the national economy. Compared to other sectors, manufacturing industry provides special opportunities for capital accumulation, economies of scale and technological progress (Szirmai, 2009).

The main drivers of intensive industry development and its structural changes are: knowledge, skills, innovation, technology, demand, resource efficiency, investments, company size, activities of the value chain, agglomeration and industrial policy (Mićić, 2015). In other words, technology is a factor that largely determines the characteristics of structural changes in the economy and industry.

The process in which the economic structure evolves under technological development can be explained in the following way: investment in R&D drives the development of new technologies, installation of capital stock brings new technical processes into sector production, new and old technical processes within a sector exchange their relative weights in production as they are phased in or out, and sectors evolve or transform over time (Pan, 2006).

Authors exploring economic and industrial development of Serbia consider that the most important problems of Serbian economy are structural discrepancies, obsolete technology, a low level of investments, high production costs, the social function still dependent on companies, inefficiency, ecological requirements, but also low exports, incompatibility with the EU standards, and a lack of comprehension of industrial processes in the EU (Jakopin & Bajec, 2009).

The main feature of structural changes in the economy of Serbia in the last two decades is deindustrialization accompanied by inadequate implementation of transition and privatization. Hence, there is the necessity of formulating new industrial policy that will be based on: export-oriented reindustrialization (Mićić & Zeremski, 2011), identifying and supporting propulsive sectors and industries (Aranđelović, Petrović-Ranđelović, & Marjanović, 2013), and creating incentives for specific companies and sectors by public authorities (Kočović & Radovanovic, 2013).

Analysis of Serbian industry is enriched including topics such as R&D, technology, innovation. New industrial policy in Serbia should be based on research and development (R&D), new technologies, education, effective investments and integrative networking of all key partners in all phases of reproduction (Leković & Mićić, 2013). It also recognized the necessity of introducing innovations in order to increase the technological level of the industry and improve competitiveness in the international market (Savić, Bošković & Mićić, 2012). Starting from the view that the development of science and technology essentially defines the intensity and speed of economic growth, domestic authors are also researching the capabilities of the Serbian economy to create and commercialize knowledge and technology. One of the approaches is the concept of national innovation system, which is based on the assumption that the research system is part of a larger system that includes economy, institutions, academic community and environment (Kutlača & Semenčenko, 2005).

The main objective of this paper is to point out the importance of manufacturing industry structure, technology profile and competitiveness as general conditions of sustainable economic development. In order to reveal relative position of Serbian manufacturing industry, its characteristics are compared to selected industrialized and industrializing EU countries.

2. METHODOLOGY

In empirical studies and literature there are various indicators of industry structure, technology profile and competitiveness. In this paper, base index of industrial production was used with a goal to determine general trend and dynamics of the development of the Serbian economy in the last two decades. As the base period was used 1990 in order to perceive the relative decline in the level of industrial production in the period 1991-2013. Structural changes in the manufacturing industry of Serbia were analyzed on the basis of gross value added (GVA).

Comparative research method was applied for evaluation of growth rate of manufacturing industry. Growth in industrial production in Serbia was compared to the growth rates of manufacturing industry of selected industrialized and industrializing economies. Countries were classified in two groups according to the classification presented by United Nations Industrial Development Organization (UNIDO, 2013). Selected countries from group of industrialized economies are: Czech Republic, Hungary, Slovenia, Slovakia and from industrializing - Bulgaria, Croatia, Poland, Romania, Serbia.

Technology structure of Serbian industry was analysed using OECD classification of industries by technological intensity. Starting from the premise that technological advances are a key determinant of productivity growth and international competitiveness, OECD has made a classification of industries based on technological intensity. An analysis of investments in research and development and the results of this activity, the OECD has ranked all manufacturing industries in 4 categories: high technology, medium-high technology, medium-low technology and low technology (OECD, 2005).

Competitiveness of manufacturing industry was analyzed using data on CIP index which is based on understanding industrial competitiveness as the capacity of countries to increase their presence in international and domestic markets whilst developing industrial sectors and activities with higher value added and technological content. The CIP index consists of eight sub-indicators grouped along three dimensions of industrial competitiveness: 1) countries' capacity to produce and export manufactures, 2) technological deepening and upgrading, 3) world impact (UNIDO, 2013).

3. INDUSTRY STRUCTURE AND INDUSTRIAL GROWTH IN SERBIA

After the Second World War, Serbian economy was characterized by rapid industrialization that affected the overall socio-economic revival of the country. After 1990, breakup of the federal state, civil war and economic sanctions led to the disintegration of industrial system of Yugoslavia. Transition process after 2000 brought intense structural transformation and creation of a market economy. Although in this period was planned an industry recovery, the process of deindustrialization is continued. Hence, many authors point out that it is necessary to carry out the process of re-industrialization in Serbia. Performance of Serbian industry after 1990 can be perceived using base index of industrial production (Figure 1). Base indexes of industrial production show that the period after 1990 was characterized by a drastic decline in industry production, and even after 2000 industrialization has not been stopped. In 2013 industrial production amounted only 47.43% of the industrial production in 1990.

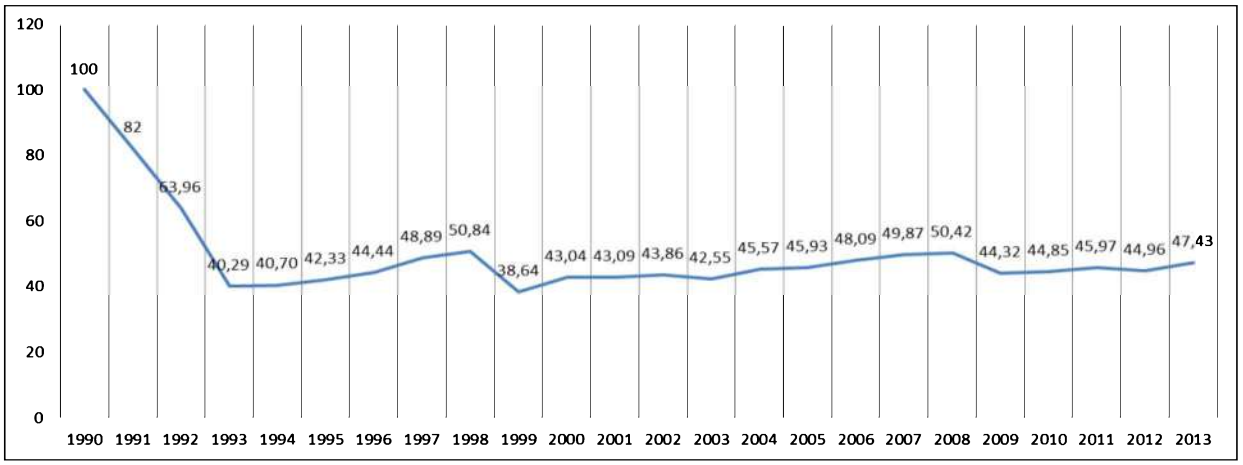


Figure 1: Indexes of industrial production in Serbia from 1990-2013.
Source: Statistical Office of the Republic of Serbia.

The decline in industrial production in Serbia after 2000 is followed with structural transformations visible in the structure of production and employment. In addition to a global trend that is reflected in the growth of the service sector and a reduction in the share of industry and agriculture, it is important to analyze the changes in the structure of industry gross value added (Table 1). The structure of industrial production in Serbia shows that the manufacturing industry had the largest share in the structure of gross value added. However, in the period 2000 to 2014 there was a reduction in the share of manufacturing industry and increase in the share of the other three industry sectors (mining and quarrying; electricity gas, steam and air conditioning supply; water supply, sewerage, waste management and remediation activities). According to the presented data, decline of manufacturing industry share in the reporting period was 7.9%.

Table 1: Gross value added by activities (current prices, structure, %)

	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Mining and quarrying	1,1	0,9	1,3	1,4	1,3	1,3	1,4	1,2	1,2	1,1	1,3	1,5	1,6	1,5	1,1
Manufacturing	**23,6**	**22,6**	**18,4**	**16,9**	**15,0**	**14,4**	**13,8**	**13,9**	**14,0**	**14,0**	**13,6**	**14,1**	**15,1**	**16,1**	**15,7**
Electricity, gas, steam and air conditioning supply	0,6	0,7	2,4	2,6	2,8	2,8	2,8	2,7	2,6	3,0	2,8	2,9	2,9	3,6	2,9
Water supply, sewerage, waste management and remediation activities	0,8	0,9	1,0	1,2	1,2	1,2	1,2	1,1	1,0	1,0	1,1	1,2	1,2	1,2	1,2

Source: Statistical Office of the Republic of Serbia.

Average growth rate of Serbian manufacturing industry in the last 15 years was 0.75% which is considerably lower than in selected countries in both country groups (Table 2). For example, average growth rates in Slovakia, Poland and Czech Republic were 8.58%, 6.05% and 4.54% respectively. Since growth rates of manufacturing industry represent and indicator of total economic results in certain period, general conclusion is that manufacturing industry of Serbia has insufficient impact on GDP and productivity growth.

It is interesting to note that almost all observed countries have high volatility of growth rates of manufacturing industry (which shows their standard deviation) and very low minimal values. This is mainly due to the impact of Global economic crisis which resulted in extremely negative growth rates of manufacturing industry in 2009.

Table 2: Growth rates of manufacturing sectors from 2001-2015, in %.

Country group/ country		Average	Min	Max	Standard deviation
Industrialized economies	Czech Republic	4,54	-14,70	12,40	6,92
	Hungary	4,43	-18,20	11,70	7,41
	Slovenia	1,83	-19,10	8,50	6,55
	Slovakia	8,58	-18,70	21,60	10,24
Industrializing economies	Bulgaria	4,40	-22,40	17,60	9,12
	Croatia	1,23	-10,40	6,20	4,79
	Poland	6,05	-3,50	14,50	5,45
	Romania	4,06	-6,60	13,30	5,44
	Serbia	0,75	-15,90	7,70	5,63

Source: Eurostat

The reason for very modest results of Serbia in terms of growth rates of industrial production lies in the development model applied in the observed period. It was a development strategy based on the significant role of the service sector, import and foreign direct investment. This model of development has not contributed to the increase in production and employment in those industries that could realize high productivity and rapid economic growth. Bearing in mind the developments in the last two decades it can be concluded that economic and industrial policy should be based on increase of production and productivity in the sectors of tradable goods an a reduction in costs in the non-tradable goods sectors, which will in turn affect the growth of competitiveness and creating an attractive investment environment.

4.TECHNOLOGY STRUCTURE AND COMPETITIVENESS OF SERBIAN MANUFACTURING INDUSTRY

In addition to the low growth rates, Serbian industry is characterized by unfavourable technological structure. As presented in Figure 1, in the structure of Serbian manufacturing industry dominate industries of low and medium-low technology intensity, while the lowest share have high and medium-high technological intensity industries. Average share of low-technology manufacturing in the period 2000-2013 is 46.51% and average share of high-technology manufacturing is 6.57%. In the observed period, only medium-low technology industries tend to increase, while other technology groups tend to decrease.

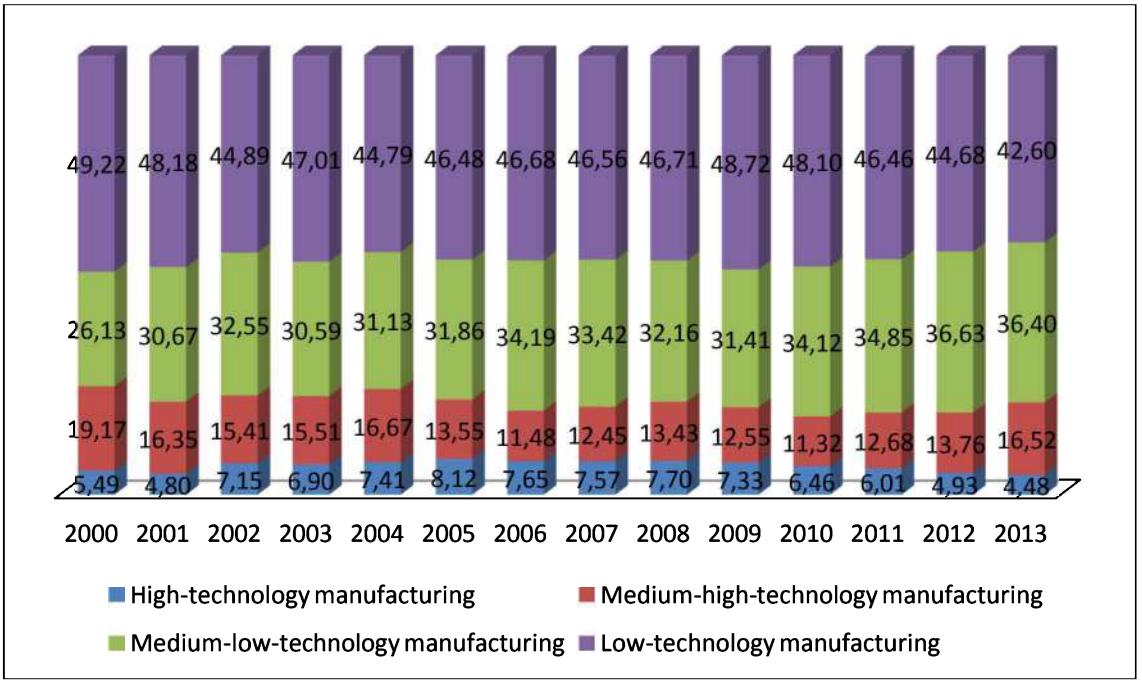


Figure 2: Technology structure of Serbian manufacturing industry.
Source: Calculated by the author on the basis of data from Statistical Office of the Republic of Serbia.

Unfavourable technology structure of Serbian industry proves that its production has low level of technology intensity, low level of finalization and a low added value. Such products are generally intensive with labour and natural resources, which has low impact on economic growth and development. Also, these results imply extremely small investments in improving the technical level of the industry, but also a lack of implementation of the results of scientific research in industrial production.

Presented data on the structure of GVA, growth rates and technological intensity of manufacturing industry of Serbia show inefficient structural reforms implemented after 2000. Structural changes have not been based on increasing the technological intensity of production which resulted in the inability of Serbian manufacturing industry to achieve a satisfactory rate of growth and competitiveness in the world market.

Manufacturing industry is not just an ingredient of development - it is the essential ingredient. Namely, manufacturing industry is: applying technological progress to production, driving innovation, diffusing innovation, developing new skills and attitudes, leading institutional development, producing beneficial externalities, stimulating modern services, generating dynamic comparative advantage, internationalizing economies, modernizing enterprises (UNIDO, 2002).

The competitiveness of a country arises from the manufacturing industry performances. Therefore, it is important to see relative positions of countries in terms of manufacturing industry competitiveness. In order to understand relative competitive position of Serbian manufacturing industry it is used Competitive Industrial Performance (CIP) index.

Competitiveness of the manufacturing industry in Serbia is at a very low level, which reveals 74th place in 2012 out of 140 analyzed countries (Table 3). All selected countries in both country groups have higher ranks which are result of more successful performances of their manufacturing industries. If the competitiveness of Serbian industry is observed in the last two decades, it can be seen that after the sharp decline during the 1990s, there was no significant improvement after 2000. Unlike Serbia, Poland, Hungary and Slovakia have significantly improved their relative competitiveness in the last twenty years.

Table 3: Ranks of competitiveness of manufacturing industries for selected countries

Country group/ country		CIP index rankings			
		1990	2000	2010	2012
Industrialized economies	Czech Republic	25	24	19	18
	Hungary	36	27	26	27
	Slovakia	37	41	27	25
	Slovenia	28	31	32	33
Industrializing economies	Bulgaria	43	63	59	59
	Croatia	33	50	54	57
	Poland	51	33	24	23
	Romania	34	44	35	34
	Serbia	54	79	75	74

Source: UNIDO, 2015.

If the CIP index value in 2012 is observed (Figure 3), industry of Serbia has the CIP index of 0.03 which is several times lower than in other countries surveyed. These data show extremely low performances of manufacturing industry in Serbia.

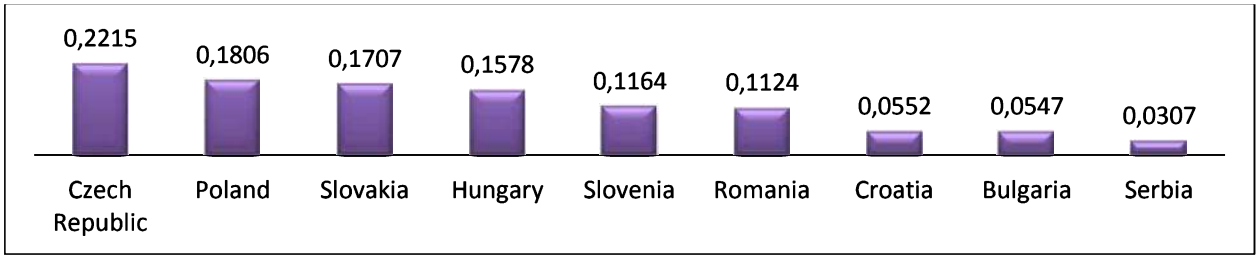


Figure 3: CIP index values in 2012
Source: UNIDO, 2015.

Although CIP index has important functions in monitoring and benchmarking industrial competitive performances, it is necessary to take it into account as a preliminary indicator of countries' industrial competitiveness. This means that using CIP index for creating industry should be complemented with other analyses on different levels (sector, industry, production task, institution, company, etc.) and topics (infrastructure, technology, labor and capital costs, innovation types).

5. CONCLUSION

Empirical analyses and economic reality have shown that successful industry and especially manufacturing industry is one of the basic determinants of long run sustainable growth. Manufacturing industry is the prime creator of value added and jobs in the economy; it is a field for application of technological development in production generates positive externalities for the rest of the economy and therefore it is a source of a country competitive ability. Manufacturing industries with higher technological intensity will create greater value added in the economy and higher growth rates.

Structural transformations in Serbian economy after 2000 were visible in the decrease of manufacturing industry share in the structure of gross value added. This was followed with variable growth rates and low average growth rate of manufacturing industry (0.75% in the period 2001-2015). The reason for this is a development strategy in this period which was based on significant role of import, foreign direct investment and service sector. Manufacturing industry was also characterized with unfavourable technology structure which means that those industries that require most R&D investments had the lowest share in Serbian GVA. According to relative industrial competitiveness indicator, CIP index, Serbian manufacturing industry competitiveness is one of the lowest in the group of industrializing countries.

Low performances of Serbian manufacturing industry indicate that there is a need to change industrial and development policy in order to re-industrialize the economy and increase production in industries that can create high productivity. To achieve this, it is critical to address constraints on technology development as important part of strategy for improving competitiveness of manufacturing industry.

Acknowledgment

Research presented in this paper was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia, under the project: "Research and Development of the Platform for Science Based Management of the Scientific and Technological Development of the Republic of Serbia", 2011-2016, reg. no. III 47005.

REFERENCES

Aranđelović, Z., Petrović-Ranđelović, M. & Marjanović, V. (2013). Structural changes in the light of new industrial strategy, *Ekonomika preduzeća*, 61, no. 5-6, 373-385.

Eurostat. (2016). Database.

Jakopin, E. & Bajec, J. (2009). Challenges of Industrial Development of Serbia, *Panoeconomicus*, 4, 507-525.

Kutlača, Đ. & Semenčenko, D. (2005). *Concept of the National Innovation System*, Institute "Mihajlo Pupin", Belgrade (printed in Serbian).

Leković, V. & Mićić, V. (2013). Industrial policy as a strategy of economic development of Serbia, *Actual Problems of Economics*, 10 (148), 327-336.

Mićić, V. (2015). Reindustrialization and structural change in function of the economic development of the Republic of Serbia, *Ekonomski horizonti*, Vol. 17, Issue 1, 15-31, Faculty of Economics, University of Kragujevac (printed in Serbian).

Mićić, V. & Zeremski, A. (2011). Deindustrialization and reindustrialization of the Serbian economy, *Industrija* 39/2, 51-68 (printed in Serbian).

OECD, (2005). Science, Technology and Industry Scoreboard 2005, OECD Publishing, Paris.

Pan, H. (2006). Dynamic and endogenous change of input-output structure with specific layers of technology, *Structural Change and Economic Dynamic*, Vol. 17, Issue 2, 200-223.

Radovanović. B. & Kočović, M. (2013). Industrial policy for economic development: the perspectives for Serbia, In: Sciences on the Crossroad / *International Scientific Conference on the Occasion of the 55th Anniversary of the IES*. Institute of Economic Sciences, Belgrade, 216-226.

Savić, Lj., Bošković, G. & Mićić, V. (2012). Orientation of the Serbian industry to innovation and quality competitiveness, *FACTA UNIVERSITATIS - Economics and Organization* 9/1, 27-38.
Szirmai, A. (2009). Industrialisation as an engine of growth in developing countries, 1950–2005, UNU-MERIT Working Papers, Netherlands.
Statistical Office of the Republic of Serbia. (2016). Database.
UNIDO, (2002). Industrial Development Report 2002/2003: Competing through Innovation and Learning, UNIDO publication identification number 414.
UNIDO, (2013). Industrial Development Report 2013, Sustaining Employment Growth: The Role of Manufacturing and Structural Change, Vienna.
UNIDO, (2015). Competitive Industrial Performance Report 2014, Vienna.

GLOBAL ELECTRONIC MARKET IN THE FUNCTION OF RETAILERS INTERNATIONALIZATION

Jelena Končar[1], Zita Petrović Katai[1], Sonja Leković[1]
[1]University of Novi Sad, Faculty of Economics in Subotica
*Corresponding author, e-mail: koncarj@ef.uns.ac.rs

Abstract: *New incentives to strengthen the domination of international retailers are the development of products with the trademark and management of product categories. The globalization of markets and a steady increase in the internationalization of retailers, thanks to scientific and technological progress through interactive resources, leads to the development of electronic marketing channels. The internationalization of the business of large retailers contributes to the growth of concentration of the European and world market retail. Large retailers using modern technological innovation and business internationalization become agents of development in the electronic market.*

Keywords*: private label, globalization, internationalization of retailers, concentration, electronic market.*

1. INTRODUCTION

The structure of retailing is transformed in the European Union and other developed economies markets from a large number of small and independent retailers to the emergence of strong national and multinational retailers. Retailers develop new strength by applying technological innovation and internationalization of business. Large retailers are taking a leading role in relations with consumers and dominant position in the marketing channels. Strengthening retail power in marketing channels in the global electronic market opens numerous intensive theoretical and practical issues:

- What are the essential components of differentiation and market positioning of large retail companies in regard to competition?
- What is the achieved level of the electronic retailers' market concentration?
- What is the strengthening of the position of global electronic retailers in marketing channels like?
- Is the concentration of retailers in favour of consumers?

Based on the issues mentioned above there is a need to analyze the concentration of retailers in the global electronic market. In this sense, it is necessary to consider the largest electronic retailers regarding consumers in marketing channel system of consumer goods. Strengthening the power of retailers in relation to other participants in the global market intensifies the process of horizontal and vertical integration in the electronic marketing channels.

2. PRIVATE LABEL AND MANAGEMENT OF PRODUCT CATEGORIES AS NEW INCENTIVES FOR INTERNATIONALIZATION

Successful market positioning in relation to competition provides retailers with differentiation and strengthening of their own private label. By the development of private label large retailers achieve higher profitability and create loyal customers. Private labels allow concentrated, powerful and large retailers to strengthen their market position in marketing channels. The following figure indicates the market share of products with private label by individual countries in Europe.

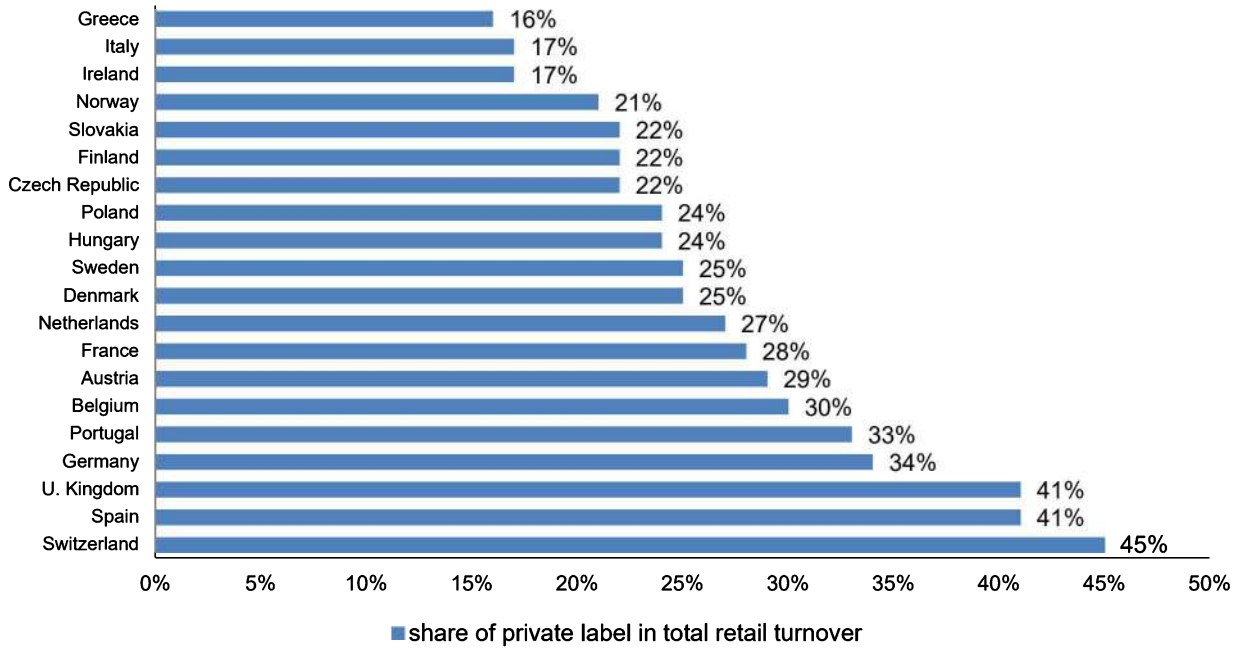


Figure 1: Market share of products with private label by individual countries in Europe in 2014 (Nielsen, 2014, p. 6)

The largest market share of products with the private label was recorded in Switzerland 45% Spain 41% and the UK 41% in 2014, but also with significant participation in other European countries. The average value of the global market share of products with the private label amounted to 16.5%in 2014. The long-term trend of development in all markets in Europe indicates continuous increase in share percentage of products with private label.

Highly noticeable processes of retail market concentration have marked the end of the last and the beginning of this century (Lovreta, Končar and Stanković, 2015, p. 213). High level of competition in Europe confirms that its intensity is an essential factor in the development of private labels. Higher concentration of retail market of food and other products of everyday consumption leads to greater share of private labels in retail. Retailers with internationalization of their business create international corporate brands.

With the development of products with the private label, retailers are creating new market-oriented brands based on a comprehensive behavior of consumer needs. Along with the development of private label there is also a parallel process of building management product categories in the internationalization of retailers. Product categories managers have the task of creating the structure of assortment, selection of producers, the arrangement of space in the retail store, all in order to achieve the set targets and product profitability. Strong suppliers who dominate in one or more categories of products, which bears greatest responsibility for achieved retailers' business results, certainly have the preference. Suppliers undoubtedly need to meet the standards in order to enter the discussion with product category managers of large retailers. Product categories managers are focused on consumer demand for producer brands, and reliability of quantity and availability of the product, in order to meet the demand of the whole chain of retail stores.

Product category managers are increasingly counting on products with private label in achieving profits nowadays. Consumers are increasingly looking for a distinctive offer from modern international retailers which is provided through a range of products with the private label. All retailers in Europe have developed a range of products with private label. The achieved level of concentration of the retail market and the participation of the trade mark in the retail market is highly positively correlated. It must be emphasized that strengthening the power of retailers would not be happening without modern technological advances that are increasingly focused on meeting the needs of consumers in the global electronic market of consumer goods. The unique technology of electronic retailing opens up new opportunities for marketing and sales on the global electronic market. The unique characteristics of e-commerce technologies are: ubiquity (Internet/Web technology is available at any location), global reach (technology across national boundaries throughout the world), the universal standard (Internet standards, as well as a collection of new technological standards), social technology (content generation technology users and social networks), personalization and customization (this technology allows the transfer of personalized messages, both individuals and groups), information density (information technology reduces costs and raises their quality), interactivity (technology

that works through the interaction with the user) and wealth (technology allows different types of messages, such as video, audio and text messages) (Končar, 2015, p. 281). Information technology has changed the structure of marketing channels where international retailers dominate in contemporary conditions with specific strategies of global performance and development.

3. ACTUAL LEVEL OF CONCENTRATION OF ELECTRONIC RETAILER MARKET

The globalization of markets and supranational regional integration contribute to the internationalization of the retail trade, which develops specific marketing and management strategies (Končar, 2015, p. 276.). The effects of the internationalization of retailing are visible on the example of the European Union single market. Intensified internationalization processes strengthen the position of retailer in relation to producers. It is difficult to imagine success in modern business environment on the international market without creating networked and long-term relationship between a larger numbers of participants in the chain of creating value for consumers (Lovreta, Končar and Petković, 2013, p. 572). Internationalization opens up new areas of growth and development in the modernization processes of markets and retailers. Higher level of market concentration of electronic retailers certainly is an important factor in the development of modern global markets and trade. Electronic retailers are getting bigger at the national and supranational level, with a growing market share that belongs to a smaller number of retailers. An important role is played by electronic retailers who take up internationalization activities and expand operations to foreign markets contributing to significantly lower level of concentration.

Internationalization and globalization lead to a higher degree of concentration and expansion of multichannel approach in trade (Končar and Lekovic, 2015, p. 361). The growth of level of concentration and strengthening the power of big electronic retailers such as Amazon.com, Apple Inc.com, J.D.com, and others, lead to changes in balance of power in marketing channels affecting the management and operation of electronic markets. Strengthening the power of retailers is conditioned by increasing the achieved level of concentration of retailing, technological development of the retail sector as well as modern management and marketing strategies. One of the most significant trends occurring in retailing is that of technological innovation (Dunne, Lusch and Carver, 2014, p. 165.). The formation and development of electronic retailing and more intense globalization of the retail activity leads to new positions in contemporary market conditions. Large retail chains are increasingly developed and become dominant in the global electronic market. Strengthening the market position of retailers intensifies changes in the development of electronic retail formats.

Table 1: Status of electronic retailing at major retailers by revenue in 2014 (Deloitte, 2015, G12, G36)

No.	Rank among largest electronic retailers	Company	Country of origin	Share of electronic retailing in total retail revenue	Growth of electronic retail revenue in 2014	Growth of electronic retail revenue from 2011-2014	Growth of retail revenue from 2009-2014
1	4	Wal-Mart Stores Inc	USA	2.5%	22.0%	24.0%	3.5%
2	6	Tesco PLC	United Kingdom	6.5%	20.0%	14.6%	1.8%
3	9	Casino Guichard-Perrachon S.A.	France	7.1%	20.1%	15.8%	13.1%
4	11	The Home Depot Inc.	USA	4.5%	36.9%	42.9%	4.7%
5	16	Costco Wholesale Corporation	USA	2.7%	18.0%	15.9%	9.5%
6	31	Metro Ag	Germany	2.4%	20.2%	56.9%	-0.8%
7	33	Target Corp.	USA	2.5%	30.0%	19.3%	2.7%
8	36	Carrefour S.A.	France	1.8%	-	-	-2.8%
9	41	GroupeAuchan SA	France	2.2%	1.7%	11.3%	6.2%
			Average	3.5%	21.11%	25.1%	4.21%
			Average of 250 largest retailers	13.2%	19.7%	22.0%	4.9%

The largest "click and brick" retailers by revenue, with the specified rank in the group of largest electronic retailers are listed in Table 1.The share of electronic retailing in the total retail turnover is from 1.8% to 7.1%.It can be concluded that retailers successfully implement electronic retailing, as indicated by the high rate of revenue growth in case of these electronic retail retailers. If we compare the growth rate of sales in

the retail and electronic retail revenue growth in general, at the level of each individual retailer, rate is several times higher. The same indicator is for all major retailers.

Growth of the global "pure play" electronic retailers has a positive influence on the growth of levels of productivity and profitability in retail phase of electronic marketing channels. Strengthening the power of electronic retailers and raising the level of concentration contributes to creating new value for customers. All this generally leads to a higher level of concentration of retail and changes relations between competitors on the global electronic market.

4. STRENGTHENING THE POSITION OF GLOBAL ELECTRONIC RETAILERS IN MARKETING CHANNELS

Strong market concentration and the dominance of a small number of major retailers change the structure of marketing channels. Modern retailers create superiority in horizontal and vertical relationships of competition in the global market. The increase in the concentration of power and strengthening the global "pure play" electronic retailers in marketing channels contributes to the internationalization and expansion of electronic markets. A higher level of concentration in the sector of electronic retailing focuses on the issues of horizontal and vertical competition within the marketing channels in the global electronic market.

Table 2: The largest global "pure play" electronic retailers by sales revenue in 2014 (Deloitte, 2015, G36-37)

No.	Rank among largest electronic retailers	Company	Country of origin	Electronic retail revenue u mil USA $	Growth of electronic retail revenue in 2014	Growth of electronic retail revenue from 2011-2014
1	1	Amazon.com	USA	70.080	15.1%	18.6%
2	2	JD.com	China	17.672	62.0%	73.2%
3	12	Vipshop Holdings Limited	China	3.701	120.2%	153.8%
4	17	Zalango AG	Germany	2.943	25.7%	63.1%
5	20	Newegg Inc.	USA	2.800	3.7%	1.6%
6	28	Vente.privee.com	France	2.311	8.0%	17.5%
7	39	ASOS Plc	United Kingdom	1.579	26.7%	25.6%
8	40	Ocado Group plc	United Kingdom	1.570	19.8%	16.6%
9	42	Overstock.com Inc.	USA	1.497	14.8%	12.4%
10	45	Ulmart, CJSC	Russia	1.300	50.0%	63.2%
				Average	34.6%	44.56%
				Average of largest electronic retailers	19.7%	22.0%

The largest global "pure play" electronic retailers according to their origin are from the countries with developed market that have developed an electronic market. Indicators of revenue growth of electronic retailers indicate higher growth rates for "pure play" electronic retailers. Revenue growth of these electronic retailers is also higher than the growth of the "click and brick" electronic retailers. Customers are becoming more and more able to make contact in physical and digital way with retailers thanks to multichannel approach. Developing strategies in-store and online technology enables the creation of links with customers through all marketing channels. Consumers are increasingly comfortable with buying through multiple channels and types of outlets, such that their purchase behavior varies not just by segment but also by purchase occasion (Palmatier, Stern and El-Ansary, 2015, p. 215). Multichannel access combines the physical and digital modes sales. By recognizing the needs of consumers, competition and market trends allow modern retailers to create long-term sustainable competitive advantage. This particular range of product categories and services provide global retailers improvement in business performance. The level of retail globalization by product category in 2014 can be seen in Table 3.

Table 3: Level of globalization by retail product categories in 2014 (Deloitte, 2015, G28)

	% Retail revenue from operations outside of the country of origin	Average number of countries in which retailers operate	% of retailers that operate in only one country
Clothing and footwear	31.6%	25.9	14.6%
The products of daily consumption	22.2%	5.3	41.3%
Technique	24.5%	8.1	33.3%
Different product categories	22.2%	11.4	36.4%
Average of largest retailers	23.4%	10.4	34.0%

Strengthening the position of large retailers by product category is the result of the development of product line selection. Retailers carry out a careful different selection of products in case of business outside the country of origin and, or if they are operating in only one country, as can be seen in Figure 2. The growth of market concentration by product category, clothing and footwear, products of daily consumption, techniques and different product categories, based the growth and strengthening of major retail chains, contributes to a growing level of efficiency in the global electronic market.

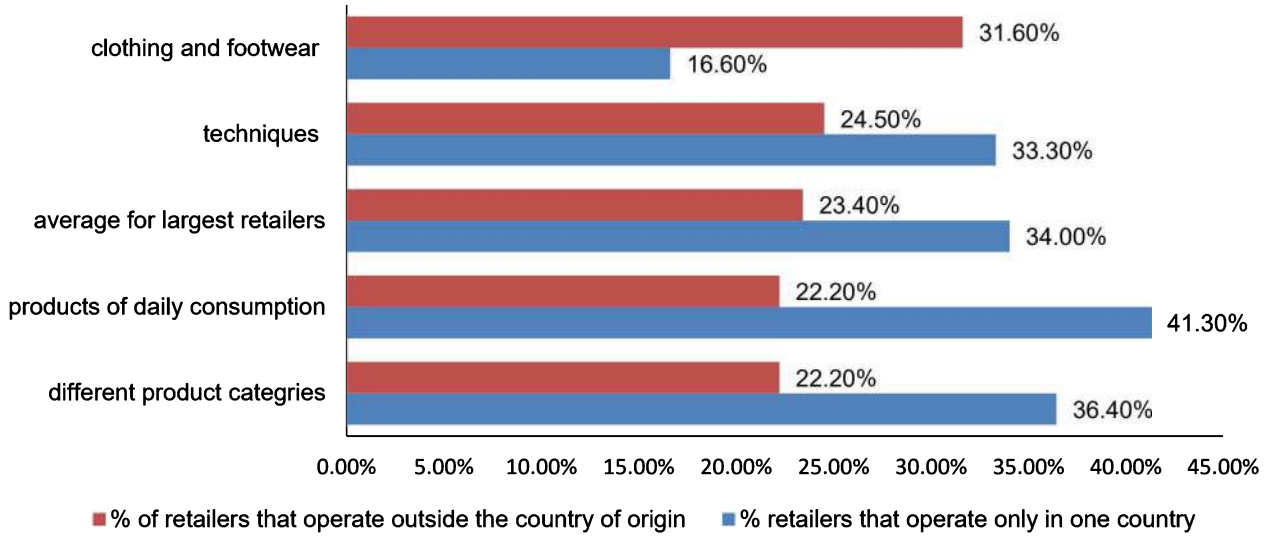


Figure 2: Retail sales by product category outside the country of origin and retailers operating in only one country (Deloitte, 2015, G28)

Online commerce is much more flexible, and what offers customers is saving time and the possibility of buying products that are not available on the local market. With the globalization of retailing customers can order online products of different brands outside the country of origin. It is anticipated that world will have 4 billion Internet users in 2019 and by 2020. Further growth of electronic retailing is linked to the growth of Internet use and the availability of infrastructure, which will facilitate the use for the consumers. Number of Internet users in the past has grown exponentially, with slower growth in recent years, but the adoption of this technology by younger users is noticeable. Its mass use and innovative potential of the Internet will certainly have an impact on the further globalization of markets, and special offers have developing countries in integration into global flows. Balanced growth of the total population in the world is expected in the preceding period, while growth in the number of Internet users has a decreasing pace of growth and stagnation in the previous period, reaching 40% of the total world population.

Effective marketing channel strategies of international retailers create a new structure of the multichannel strategy. Online catalogs are becoming leaders in the structure of the multi-channel mix. In the United States, about 74% of Internet users, age 14 and older, are “buyers”. Another 16% research products on-line (“browsers”), but purchase them off-line (Laudon and Traver, 2015, p. 378). Good multichannel strategy becomes the primary mean of achieving sustainable competitive advantages (Končar, 2015, p. 302).

5. CONCLUSION

The growing internationalization of retail activity causes changes in competitive structure of global electronic market. Product development strategy with the private label and management of product categories become the new incentives in the internationalization and the dominance of retailers. Electronic retailers internationalize their activities and contribute to the growth of the degree of concentration and change the balance of power in marketing channels. The market position of major retail chains intensifies changes in the global electronic market. Thanks to multi-channeling, retailers achieve long-term competitive advantage. Levels of retail globalization at individual product categories contribute to increasing the efficiency of electronic markets. International retailers through a multichannel strategy contribute to long-term sustainable competitive advantages in the global market.

REFERENCES

Deloitte (2015). *Global Powers of Retailing 2016, Navigating the New Digital Divide.* London: Deloitte.

Dunne P.M., R.F. Lusch & Carver J.R. (2014). *Retailing*, 8th edition, South Western, Cengage Learning.

Končar J. (2015). *Menadžment maloprodaje*, drugo izmenjeno i dopunjeno izdanje, Univerzitet u Novom Sadu, Ekonomski fakultet Subotica, Proleter, a.d.Bečej.

Končar J. & Leković S. (2015). "*The Impact of Multichannel Approach on Mobile Commerce Development in the Republic of Serbia*", 3rd International Conference on Contemporary Marketing Issues ICCMI 2015, 30 June-2 July 2015, London, Kingston Business School, London UK, Alexander Technological Educational Institute of Thessaloniki (ATEI), pp. 361-365.

Laudon K.C. & Traver C.G. (2015): *E-Commerce 2015, Business. Technology. Society*, Eleventh Edition, Pearson Education Limited, Harlow England.

Lovreta S., Končar J. & Petković G. (2013). *Kanali marketinga, Trgovina i ostali kanali*, peto dopunjeno izdanje, Univerzitet u BeograduEkonomskifakultet i Ekonomskifakultet Subotica.

Lovreta S., Končar J. & Stanković Lj. (2015). "Effects of Increasing the Power of Retail Chains on Competitive Position of Wholesalers", *Acta Polytechnica Hungarica*, 12 (3), pp. 213-228.

Nielsen (November 2014). *The State Of Private Label around the World*, Nielsen Company.

Palmatier R.W., Stern L.W. & El-Ansary A.I. (2015). *Marketing Channel Strategy*, Eighth Edition, Pearson Education Limited.

Available at: www.Royal.pingdom.com 26. 03. 2016.

THE CONCEPT OF HYBRID METHOD FOR RISK ASSESSMENT IN NEW PRODUCT DEVELOPMENT

Radul Milutinović*[1], Biljana Stošić[1],

[1]Faculty of Organizational Sciences, University of Belgrade
*Corresponding author, e-mail: radul.milutinovic@fon.bg.ac.rs

Abstract: *Contemporary companies are forced to assume significant risk if they want to quickly and successfully launch a new product to the market. Therefore, the ability of effective risk management is considered as very important factor in the implementation of high-risk projects of product innovation. This paper presents a new hybrid method for risk assessment suitable for new product development (NPD) projects, created by connecting two well-known methods, Risk Breakdown Structure - RBS and Failure Mode and Effects Analysis - FMEA. The RBS is employed as a foundation for this hybrid method. The method includes formulating of the RBM matrix, which is based upon two dimensions (1) Work Breakdown Structure (WBS) - presented through phases of Stage-Gate model and (2) Risk Breakdown Structure (RBS) - presented through categories of risk that can significantly impact the innovation project. FMEA method is used due to its way of overall importance of risk calculation i.e. the way risk priority number is calculated.*

Keywords*: hybrid model, risk assessment, risk categories, NPD, RBS, FMEA, Stage-Gate*

1. INTRODUCTION

In today's unpredictable business surrounding companies have to be prepared to adapt and develop if they want to survive. Therefore, most of nowadays companies with great concern refer to improvement of their innovation performance in order to achieve sustainable growth and significant competitive differentiation (Milutinovic & Stosic, 2013). Considerable number of authors and leaders from different branches identified innovation as a key driver in long-term success and profitability (Stosic, Milutinovic, Zakic & Zivkovic, 2016).

Innovation has been regarded as risky and hazardous which can be confirmed by the fact that only one of sixty product ideas brought into the innovation process reached commercial success, and about 80% of man-hours are used on unsuccessful products in innovation ventures (Epstein, 2002). Also, it is estimated that about 46% of the funds, invested by company in the development and launch of new products/services is related to unsuccessful projects (http://www.prod-dev.com/stage-gate.php).

Having in mind that innovation ventures carry considerable risk that cause more than one half of the individual innovation undertakings to fail, companies have to find the way to succeed in commercial success. In order to minimize the risk in innovation projects companies use the risk management as one of the most influential factors for innovation project success. By itself, risk can appear in any aspect of innovation project and consequently can result in cost overruns, schedule delays and even poor quality (Murray, Grantham, & Damle, 2011). Therefore, risk management in innovation projects is an important topic for practitioners and academic scholars and therefore today it is being increasingly incorporated into business models. Implementation of effective risk management strategy leads to increased performance in NPD (new product development) firm (Mua, Peng, & MacLachlan, 2009). According to survey conducted by Murray, Grantham, & Damle, (2011) the majority of participants - managers with extensive project management experience, confirmed that have used some kind of risk management techniques.

This paper presents new hybrid method for risk assessment, as a part of the overall risk management process in the NPD projects. The main goal is to provide a structured process that identifies how objectives, in this case phases of model Stage-Gate, may be affected. Additionally to analyze the risk in term of consequences and their probabilities before deciding on whether further treatment is required. Risk assessment indicates risk identification, description of the risks, and estimating their respective probabilities and impacts (IEC/FDIS, 2009). While the tools and techniques used for risk identification are designed to assist a project manager in gathering information which influence a project's objectives, scope, and budget; risk assessment provides an insight concerning how likely something is to go wrong and what the associated impact will be (Murray, Grantham, & Damle, 2011).

Starting from this point, the paper is organized in two main sections, first related to theory on risk management, especially in NPD projects, as well as explanation of concepts of RBS and FMEA method. The second one is related to description of the new hybrid method, its structure and the way the overall risk relevance is calculated combining aforementioned methods.

2. PROJECT RISK MANAGEMENT BASIC CONCEPTS

The essential purpose of risk management is to improve project performance via systematic identification, appraisal and management of project related risk (Chapman, & Ward, 1996). The risk management process can be considered as a very useful aid to decision making regarding uncertainty and the possibility of future events and their impact on established objectives. It includes the application of logical and systematic methods for (IEC/FDIS, 2009):

- communicating and consulting throughout this process;
- establishing the context for identifying, analyzing, evaluating, treating risk associated with any activity, process, function or product;
- monitoring and reviewing risks;
- reporting and recording the results appropriately.

Different approaches to the process of risk management are used in the literature and practice, according to the number of stages, location, nature and manner of the risk events occurrence (Table 1).

Table 1: Risk Management Process – selected approaches

References	Risk Management Process
Bruckner, List, & Schiefer, 2001	Goal definition review, Risk Identification, Risk Analyses, Risk Planning, Risk Tracking, Risk Control
Smith & Merritt, 2002	Identify Risks, Analyze Risks, Prioritize and map risk, Resolve Risks, Monitor Risks
PMI, 2004	Risk Management Planning ,Risk Identification, Qualitative Risk Analysis, Quantitative Risk Analysis, Risk Response Planning, Risk Monitoring & Control
Rafele, Hillson & Grimaldi, 2005	Risk identification aid, Risk assessment, Comparison of alternatives, Risk reporting
IEC/FDIS, 2009	Risk identification, Risk analysis, Risk evaluation, Risk treatment, Monitoring & Review
PMI, 2009	Identification, Assessment, Treatment, Planning, Treatment, Monitoring, Documentation

Risk management is one of the functional areas of project management. Speaking of innovation projects, a high degree of risk intensifies the importance of this functional area. Innovation and innovation projects, as a rule, assume the impact of various risk factors, which importance rises with the increase of investments, but also of other factors that affect the expected innovation project success (Stosic, 2013).

Risk management in innovation projects implies analysis of all factors that could affect the innovation process. Therefore, it is desirable that the project managers – managers for risk management, as well as some of operational managers, are involved in the process of risk assessment (Stosic, 2013). Due to a large number of risk events that can be identified in an innovation project, it is often very difficult to perform their proper systematization.

Accordingly, the paper proposes a new hybrid model for risk assessment, which is constructed by combining two well-known methods, RBS and FMEA methods, and that can offer better structure of risk sources and their impact.

Based on extent literature review, this paper presents different risk categories that can affect project objectives and that can be observed for various projects (Table 2).

Table 2: Project risk categories – selected authors

Author	Risk Categories
Godfrey, 1996	Political, Environmental, Planning, Market, Economic, Financial, Natural, Project, Technical, Human, Criminal, Safety,
Akintoye & MacLeod, 1997	Environmental, Political, Social and Economic, Contractual arrangement, Financial, Construction, Market/industry, Company, Development in IT, Project
Tummala & Burchett, 1999	financial and economic, political and environmental elements, design, site construction, physical elements, and “acts of God”

Doering & Parayre, 2000	Technological risks, marketing risks and organizational risks
Miller & Lessard, 2001	Market-related risk, Completion risk and Institutional risk
Keizer, Halman & Song, 2002; Keizer, & Halman, 2007	Technological risk, Organizational risks and Business risks
Hall, Hulett & Graves, 2002	Management Risk, External Risk, Technology Risk
Ghosh & Jintanapakanont, 2004	Financial and Economic Risk, Contractual and Legal Risk, Subcontractors related Risk, Operational Risk, Safety and Social Risk, Design Risk, Force Majeure Risk, Physical Risk, Delay Risk
Nielsen, 2006	Delivery/Operational Risk, Technology Risk, Financial Risk, Procurement Risk, Political Risk, Environmental Risk, Social Risk, Economic Risk
Murray, Grantham, & Damle, 2011	Technological and Operational Risk, Financial and Economic Risk, Procurement and Contractual Risk, Political Risk, Environmental Risk, Social Risk, Regulatory and Legal Risk, Safety Risk, Delay Risk

For the purpose of this paper, i.e. generation of RBM matrix for NPD projects, categorization proposed by Keizer, Halman & Song (2002) will be used. These categories of risk are applied since they are recognized as critical success factors in product innovation projects. Three main risk categories Technology risks, Organizational risks and Business, and twelve subcategories are identified (Table 3). These categories are chosen considering their application for risk identification and assessment for new product development projects, representing one of innovation project category. *Technology risks* refer to product design, manufacturing technology and intellectual property. *Organizational risks* refer to internal project management and external organizational influences. *Business risks* refer to issues such as the impact of a new product on the company's brand positioning, consumer and trade acceptance, commercial viability, and the potential actions of competitors (Keizer, Halman, & Song, 2002).

Table 3: NPD risk categories (adapted from Keizer, Halman, & Song, 2002; Keizer, & Halman, 2007)

	Level 1	Level 2
NEW PRODUCT DEVELOPMENT PROJECT RISKS CATEGORIES	Technology risks	Product technology risks
		Manufacturing Technology Risks
		Intellectual property Risks
	Organizational risks	Supply chain & Sourcing risks
		Screening & Appraisal
		Organizational & Project Management Risks
	Business risks	Product Family & Brand Positioning risks
		Consumer Acceptance Risks
		Trade Customer Risks
		Competitor Risks
		Commercial Viability Risks
		Public Acceptance Risks

This categorization of new product development risk can be found further decomposed on 142 more project issues which are, also, recognized as critical factors for successful NPD (Keizer, Halman, & Song, 2002).

2.1. Basic concept of the RBS method

According to Hillson, Grimaldi & Rafele (2006) RBS is a tool that groups the sources of risk that may affect the project and organize them in a way that allows a detailed analysis of the overall risk exposure of the project. RBS method is based on two dimensions: work breakdown structure – WBS and risk breakdown structure - RBS. This dimensions of WBS and RBS enable generation of a matrix structure known as *Risk Breakdown Matrix* (RBM) (Figure 1), which allows members of the project team to manage risk at all levels of the specific project (Rafele, Hillson, & Grimaldi, 2005). First step is related to definition of WBS structure of project, in this case NPD project, with all major and minor tasks. Second step is related to risk identification and classification through RBS. Third step can be defined as a process of fulfilling the RBM matrix (Figure 1)

with probability of occurrence risk ($P_{i,j}$) and impact of risk ($I_{i,j}$) for every activity and phase i.e. work package (WP).

The value of each cell in the RBM is calculated considering two components: the probability of risk event occurrence (P) and the degree of potential impact (I) that risk event can have. Probability is related to the presence of a risk in the RBS, and impact refers to the consequence of that risk in the WBS. This can be expressed by the formula:

$$R_{WP,i} = \sum_{j=1}^{n} P_{i,j} * I_{i,j} \quad (1)$$

$P_{i,j}$ is the probability of occurrence of risk- j in WP- i;
$I_{i,j}$ is the impact of risk- j in WP- i;
$R_{WP,i}$ is the global incidence of risks in WP- i.

			RBS						
			Risk sources						
WBS Work Packages			$P_{i,1}$	$P_{i,2}$	$P_{i,3}$	...	$P_{i,n}$	ΣR	WPs order
	WP_1	$I_{1,j}$						**$\Sigma R_{1,j}$**	
	WP_2	$I_{2,j}$							
	WP_3	$I_{3,j}$		**$P_{2,3}*I_{3,2}$**					
	WP_4	$I_{4,j}$							
	...	...							
	WP_m	$I_{m,j}$							
	ΣR		**$\Sigma R_{i,1}$**						
	Risk sources order								

Figure 1: RBM matrix (adapted from Rafele, Hillson, & Grimaldi, 2005)

In this paper, identification of risk events in innovation project i.e. new product development, realization was done using the two dimensional framework emphasizing that organization can identify, analyze, respond to and monitor the major risks over the process by using RBS. Risk events are structured in three major categories on the first level, and twelve subcategories on the second level of hierarchical system (Table 3).

2.2. Basic concept of the FMEA method

Failure Mode and Effect Analysis – FMEA, is a systematic method for identifying and preventing product and process problems before they occur. The main application of this method is to prevent defect occurrence, enhance safety, and increase customer satisfaction. Therefore, FMEA identifies and prioritize possible imperfections in products design or process development stages (McDermott, Mikulak & Beauregard, 2009).

One of the most cited definitions for FMEA method was given by US MILITARY STANDARD 1629A (1980) describing method as "the set of procedures by which each potential failure mode in a system is analyzed to determine the results or effects thereof on the system and to classify each potential failure mode according to its severity".

A several types of FMEA's have been used whenever failures would mean potential harm or injury to the user of the end item being designed (Table 4).

Table 4: FMEA types (http://www.npd-solutions.com/fmea.html; IEC/FDIS, 2009)

Types	Usage
System	focuses on global system functions
Design or Construction	focuses on components and subsystems
Process	focuses on manufacturing and assembly processes
Service	focuses on service functions
Software	focuses on software functions

The main idea of FMEA is to generate a risk priority number (RPN) for each failure mode. Risk priority number is determined by following three factors:

- *Severity* - the consequence of the failure should it occur (McDermott, Mikulak & Beauregard, 2009)
- *Occurrence* - the probability or frequency of the failure occurring (McDermott, Mikulak & Beauregard, 2009)
- *Detection* - the ability of detection technique or method(s) to detect the risk event with enough time to plan for a contingency and act upon the risk (Carbone & Tippett, 2004).

RPN can be described as a weighted assessment number used for prioritizing the highest risk items. The Risk Priority Number is a mathematical product of the numerical Occurrence (O), Detection (D) and Severity (S) ratings (Equation 2). All of these factors are rated on a scale ranging from 1 to 10 (Table 5, 6, 7). Ratings that affect the RPN value are taken based on the universal scale or they may be formulated for a particular system that is analyzed (Ericson, 2015).

$$RPN = O * S * D \tag{2}$$

Table 5: Occurrence Rating Criteria

Occurrence	Rating	Description
Minor	1-2	An unlikely probability of occurrence during the observed period.
Low	3-4	A remote probability of occurrence during the observed period.
Moderate	5-6	A moderate probability of occurrence during the observed period.
High	7-8	A high probability of occurrence during the observed period.
Extreme	9-10	Risk is almost inevitable during the observed period.

Table 6: Severity Rating Evaluation Criteria

Severity	Rating	Description
Minor	1-2	Risk is of such minor nature that the strategic partner will probably not detect the risk.
Low	3-4	Risk will result in slight strategic partner annoyance and/or slight consideration of negative decision.
Moderate	5–6	Risk will result in strategic partner dissatisfaction and annoyance and/or consideration of negative decision.
High	7–8	Risk will result in high degree of strategic partner dissatisfaction and cause serious consideration of a negative decision.
Extreme	9–10	Risk will result in major strategic partner dissatisfaction and cause negative decision.

Table 7: Detection Rating Criteria

Detection	Rating	Description
Very High	1–2	Detection method is highly effective and it is almost certain that the risk will be detected with adequate time.
High	3–4	Detection method has moderately high effectiveness.
Moderate	5–6	Detection method has medium effectiveness.
Low	7–8	Detection method is unproven or unreliable; or effectiveness of detection method is unknown to detect in time.
Very Low	9-10	There is no detection method available or known that will provide an alert with enough time to plan for a contingency.

Identification and prioritization of critical components are followed by an effort on reducing the criticality of the components in the system that have the highest priority. Those efforts should first be addressed to the highest ranking critical items. The main idea is to reduce the RPN by eliminating or controlling the cause of the failure; or reducing the ratings of severity, occurrence and detection (Puente, Pino, Priore & Fuente, 2002).

3. GENERATION OF THE HYBRID METHOD

The aim of this paper is said to be construction of a new tool for risk assessment in projects of product innovation. This new method is developed based on two previously defined methods - RBS and FMEA. The main reason for using RBS method is its structure, which is suitable for risk identification, primarily in the sense of possible connection of risk sources with phases of the innovation project. As it was pointed out, this is reflected through RBM matrix and its two dimensions - WBS and RBS.

Regarding WBS structure, stages of the well-known Cooper's Stage-Gate model for managing innovation projects have been used. Those are: *preliminary investigation*, *build a business case*, *development*, *testing and validation* and *full production and launching to the market* (Cooper, 2011). On the other hand, the main reason for using FMEA method is detection rating which does not exist in RBS method, and that can have a major impact on the overall relevance of the risk.

The basic idea of a hybrid method is a new way for calculations of overall risk relevance, which is adapted to identify and assess the risk of innovation projects. Therefore, the calculation is based on the following assumptions:

- P→O => the probability rating (P) - occurrence of risk events from the RBS method, is mapping into occurrence rating (O) - frequency with which a given risk occurs from the FMEA method;
- I→S => the impact rating (I) – the impact of risk events from the RBS method, is mapped into severity rating (S) - seriousness of the effect if a given failure occur from the FMEA method.

Considering these assumptions and individual formulas for both methods (RBS and FMEA), new way for calculating RPN has been proposed:

$$\begin{aligned} R &= P * I(RBS) = O * S(FMEA) \\ RPN &= O * S * D(FMEA) \\ RPN &= R * D \end{aligned} \tag{3}$$

This formula has been adapted for use in the field of innovation projects since it involves risk categories (risk sources) that are related to new product development (Table 3) and to impact that these categories have on the phases of the Stage-Gate model.

First step in the analysis is to define dimensions of WBS and RBS. Second step is to determine the probability of the occurrence of risk categories that are related to innovation project. This is followed by the determination of impact that this categories can have on certain phases of innovation project. Then the probability that a certain category of risk will be detected in time is determined, that is, before realization of its negative impact and eventually, calculation of RPN is performed.

Table 8: Hybrid RBM matrix

			Work Breakdown Structure						
			Preliminary Investigation	Build the business case	Development	Test and validation	Production and full launch	∑R	Risk sources order
Risk Breakdown Structure	Technology risks	Product technology risks							
		Manufacturing Technology Risks							
		Intellectual property Risks			$R_{3,3}$*$D_{3,3}$				
	Organizational risks	Supply chain & Sourcing risks							
		Screening & Appraisal							
		Organizational & Project Management Risks							
	Business risks	Product Family & Brand Positioning risks							
		Consumer Acceptance Risks							
		Trade Customer Risks							
		Competitor Risks							
		Commercial Viability Risks							
		Public Acceptance Risks							
		∑R						The overall risk of the project	
		Risk sources order							

As can be seen in Table 8, the overall risk relevance for risk category *Intellectual property* that can influence the *Development* phase is calculated by multiplying the risk relevance $R_{3,3}$ ($P_{2,2}$*$I_{2,2}$ or $O_{2,2}$*$S_{2,2}$), and detection rating for this risk category ($D_{3,3}$).

4. CONCLUSION

Bearing in mind that one of the most important characteristics of innovation projects is high risk taking, it is essential that companies incorporate risk management into their processes of innovation if they want to avoid exceeded costs, disposal of planned activities and poor quality of new products. Furthermore, of great importance for the companies is to use different tools for risk assessment, or to be able to adjust them to different types of projects, regarding that the various projects are being affected by different risk categories.

For this reason, the paper presents an outline of hybrid method for risk assessment that is suitable for NPD projects. Featured hybrid method can be very important in terms of identifying the impact of risk categories on the stages of model for new product development. Moreover, this method is very useful and has a lot of benefits. Some of these benefits facilitate the risk management process on a particular project, while others are relevant across set of projects. Once the RBS of NPD project is defined, it can be used in a variety of ways. Categorization of risk using RBS and consequently proposed hybrid method, provides a numerous additional insights of risk exposure on the project: understanding the type of risk exposure on the project, exposing the most significant sources of risk to the project, revealing the roots causes of risk, allowing risk responses to be developed for root causes or depended groups of risks, etc. (Hillson, 2003). Also, this tool is helpful when it comes to risk identification, assessment, comparison of projects, risk reporting, lessons learned for future projects.

Having in mind that project phases consist of various activities it should be recommended to apply this method also on the level of each specific phase. In that way the principle of decomposition can be consistently engaged on every level of the project, which enables better identification of risk parameters. This is also in line with the agile approach, thus representing one of the key features and advantages of the proposed method.

REFERENCES

Akintoye, A. S., & MacLeod, M. J. (1997). Risk analysis and management in construction. *International journal of project management*, *15*(1), 31-38.

Bruckner, R. M., List, B., & Schiefer, J. (2001). Risk-management for data warehouse systems. In *Data Warehousing and Knowledge Discovery* (pp. 219-229). Springer Berlin Heidelberg.

Carbone, T. A., & Tippett, D. D. (2004). Project risk management using the project risk FMEA. *Engineering Management Journal*, *16*(4), 28-35.

Chapman, C., & Ward, S. (1996). *Project risk management: processes, techniques and insights*. John Wiley.

Cooper, R. G. (2011). *Winning at new products: Creating value through innovation*. Basic Books.

Doering, D. S., & Parayre, R. (2000). Identification and assessment of emerging technologies. *Wharton on Managing emerging technologies, GS Day, PJH Schoemaker and RE Gunther, Eds. John Wiley and Sons Inc., Hoboken, New Jersey*, *75*.

Epstein, M. (2002). *Risk Management of Innovative Project*. Helsinki School of Economics.

Ericson, C. A. (2015). *Hazard Analysis Techniques for System Safety*. John Wiley & Sons.

Ghosh, S., & Jintanapakanont, J. (2004). Identifying and assessing the critical risk factors in an underground rail project in Thailand: a factor analysis approach. *International Journal of Project Management*, *22*(8), 633-643.

Godfrey, P. S. (1996). *Control of risk a guide to the systematic management of risk from construction*. CIRIA.

Hall, D., Hulett, D., & Graves, R. (2002). Universal risk project final report. *Available from the PMI Risk SIG*.

Hillson, D. (2003). Using a risk breakdown structure in project management. *Journal of Facilities Management*, *2*(1), 85-97.

Hillson, D., Grimaldi, S., & Rafele, C. (2006). Managing project risks using a cross risk breakdown matrix. *Risk management*, 61-76.

IEC/FDIS 31010:2009(E) (2009). *Risk management — Risk assessment techniques*. International Electrotechnical Commission.

Keizera, J. A., Halman, J. I., & Song, M. (2002). From experience: applying the risk diagnosing methodology. *Journal of product innovation management, 19*(3), 213-232.

Keizer, J. A., & Halman, J. I. (2007). Diagnosing risk in radical innovation projects. *Research-Technology Management*, *50*(5), 30-36.

Miller, R., & Lessard, D. (2001). Understanding and managing risks in large engineering projects. *International Journal of Project Management*, *19*(8), 437-443.

Milutinovic, R., & Stosic, B. (2013). Key elements of innovation project management in services. *Management*, 69(4), 65-73. DOI: 10.7595/management.fon.2013.0027
McDermott, R., Mikulak, R. J., & Beauregard, M. (2009). *The basics of FMEA*. CRC Press.
Mu, J., Peng, G., & MacLachlan, D.I. (2009). Effect of risk management strategy on NPD performance. Technovation, 29, 170–180.
Murray, S. L., Grantham, K., & Damle, S. B. (2011). Development of a generic risk matrix to manage project risks. *Journal of Industrial and Systems Engineering*, *5*(1), 35-51.
Nielsen, K. R. (2006). Risk management: Lessons from six continents. *Journal of management in engineering*, *22*(2), 61-67.
Project Management Institute, (PMI). (2004). *A guide to the project management body of knowledge (PMBOK® Guide)*.Project Management Institute, Pennsylvania.
Project Management Institute - (PMI). (2009). *Practice Standard for Project Risk Management.* ISBN: 978-1-933890-38-8.
Puente, J., Pino, R., Priore, P., & Fuente, D. (2002). A decision support system for applying failure mode and effects analysis. *International Journal of Quality & Reliability Management*, 19(2), 137-150.
Rafele, C., Hillson, D., & Grimaldi, S. (2005). Understanding project risk exposure using the two-dimensional risk breakdown matrix. Project Management Institute Global Congress Proceedings – Edinburgh, Scotland.
Smith, P. G., & Merritt, G. M. (2002). *Proactive risk management: Controlling uncertainty in product development*. New York: Productivity Press.
Stošić, B. (2013). *Menadžment inovacija - inovacioni projekti, modeli i metodi.* FON, Beograd.
Stosic, B., Milutinovic, R., Zakic, N., & Zivkovic, N. (2016). Selected indicators for evaluation of eco-innovation projects. *Innovation: The European Journal of Social Science Research*, 1-15. DOI: 10.1080/13511610.2016.1157682
Tummala, V. R., & Burchett, J. F. (1999). Applying a risk management process (RMP) to manage cost risk for an EHV transmission line project. *International Journal of Project Management*, *17*(4), 223-235.
US MILITARY STANDARD, MIL-STD-1629A. (1980). *Procedures for Performing a Failure Mode, Effect and Criticality Analysis*. Department of Defense, USA.

Acknowledgement
This work was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia through project "Research and development platform for scientific support in decision-making and management of scientific and technological development in Serbia", 2011-2016, No III 47005.

INDEX OF POTENTIAL FOR TECHNOLOGY ENTREPRENEURSHIP DEVELOPMENT: PRACTICE FROM SERBIA

Jovana Rakićević*[1], Maja Levi Jakšić[1], Milica Jovanović[1]
[1]University of Belgrade, Faculty of organizational sciences
*Corresponding author, e-mail: jovana.rakicevic@fon.bg.ac.rs

Abstract: *This paper explores the potential for technology entrepreneurship development, considered as the main force for the prosperity of countries. An index of Technology Entrepreneurship Development Potential (TED-pot) is created, in order to enable the cross-countries comparison. The index includes four indicators grouped into two pillars – ICT potential and Entrepreneurial potential. The index is applied on six ex-Yugoslav countries and the EU for the period 2009-2014. The study is aimed at determining whether the potential of Serbia lies in the entrepreneurial IT sector, which is proven to be the case.*

Keywords*: technology, entrepreneurship, development, potential, index, Serbia*

1. INTRODUCTION

In the modern turbulent and fast-changing business environment, technological progress, innovation, and sustainability are recognized as the most important forces influencing business success. Entrepreneurs are change agents seen as those who could change the overall living standards and work conditions. Apart from creating wealth from their entrepreneurial ventures, they also create jobs and represent the main 'force' acting against unemployment. Simply put, they create conditions for a prosperous society. Combining these views on the modern business world, sustainable technology entrepreneurship stands out as the modern concept contributing to actual practice and development.

As elaborated in the publication *"Entrepreneurship in Serbia – A Necessity or an Opportunity?"* (CEVES, 2014), Serbia is a country where foreign direct investments cannot replace the creativity and energy of thousands of people driven by entrepreneurial ventures and ideas. In Serbia, entrepreneurship should not be 'second-rate' because our country is an economy of small and medium-sized enterprises (SMEs), which actually are entrepreneurial ventures. We need to be aware that most of the big companies have the roots in entrepreneurial ventures, and started as small companies. If we pay attention to small businesses, with a little patience, we will have the opportunity to create a great economy.

Additionally, if we assume that technology is the basis for development, and ICT is the backbone of technology today, the potential for countries' development lies in the ICT sector. SIEPA (2015) published a brochure on Serbian ICT sector, pointing out that computer software is one of Serbia's main export products. Serbia is globally acclaimed for being the biggest exporter of raspberries, but the value of exported software and services is almost twice as big as the export of raspberries. In 2013, Serbian ICT industry was ranked 40th globally when it comes to value of exported software. This made ICT one of the most successful and export-oriented industries in Serbia. Sector's export is on the constant rise especially when it comes to export of computer and information services i.e. software development. In 2008 the value of exported services was €96 million and by 2013 it reached as much as €265 million, which is amazing 165% increase. Serbian IT market was worth around €410 million in 2013, which is still far less than before the global financial crisis outbreak in 2008, when it was worth €550 million. The potential for reaching and exceeding that result is evident (SIEPA, 2015).

Starting from such an entrepreneurial, technology-oriented way of thinking, and in order to test the potential for the development of technology entrepreneurship in Serbia, we created an index of potential for technology entrepreneurship development (TED-pot), and afterwards performed a comparative analysis which encompasses six ex-Yugoslav countries and the EU. The main idea is to compare Serbia with the average for the EU, and with the other regional countries hypothesizing that fostering technology entrepreneurship is the strategic development orientation for Serbia. The aim of the paper is to determine whether the Serbian development potential lies in the entrepreneurial IT sector, i.e. to prove that Serbian development potential lies in technology entrepreneurship. The analysis covers the period 2009-2014.

The rest of the paper is organized as follows. In Section 2 we briefly define the technology entrepreneurship concept and highlight the importance of technology start-ups in modern business. In Section 3 we present the created index of Technology Entrepreneurship Development Potential (TED-pot). Section 4 presents the comparative analysis, results and discussion. Section 5 shows the limitations of this study, future work directions, and concludes the paper.

2. TECHNOLOGY ENTREPRENEURSHIP AND IMPORTANCE OF TECHNOLOGY START-UPS

The importance of entrepreneurship, especially technology (technological, hi-tech or techno-) entrepreneurship is evident in today's business. As Harms and Walsh (2015) highlight, most of today's entrepreneurial heroes such as Bill Gates, Steve Jobs, Mark Zuckerberg and Craig Venter have one thing in common – they are technology entrepreneurs "who base their success on the recognition, creation and exploitation of an opportunity for value creation that a technology has offered". Therefore, we could notice that technology entrepreneurship drives the prosperity in individuals, firms, regions, and nations. It lies in the heart of many important debates that bring together all the participants of the famous Triple Helix model – academia, industry and government. However, according to Bailetti (2012), unless a generally accepted definition of technology entrepreneurship is established, these debates lose their focus.

In his work, Bailetti (2012) defines technology entrepreneurship as "an investment in a project that assembles and deploys specialized individuals and heterogeneous assets that are intricately related to advances in scientific and technological knowledge for the purpose of creating and capturing value for a firm". Technology entrepreneurs have a task to bring together the technical world and the business world in a profitable way (Byers et al., 2011). Therefore, we could observe technology entrepreneurship as the link between science and technology and the practical new value created for the customers, upgrading their living conditions and standards, contributing to the overall welfare of the economy and society (Etlie, 2000). Levi Jaksic et al. (2010) suggest a technology entrepreneurship cycle model focusing on new technology as an opportunity. They emphasize that it differs from the technology push model which is based on new technological innovation being "pushed" through the business operations with a "hope" that sustainable business strategies will be found and enable the success of the venture. The technology entrepreneurship model they present is initialized by opportunity – recognized or created as technology innovation; it has organization-wide context and entrepreneurial perspective.

Fostering technology entrepreneurship is understood as a means to release currently unexploited opportunities hidden in individuals, shelved technologies and resource combinations (Gilsing et al., 2010). Innovation is a precondition for success, but being innovative does not automatically mean new value for the customer and competitiveness. This is where technology entrepreneurship has a vital role, pushing the innovations to the market. In the future, technology entrepreneurs are asked to contribute to solutions to world problems (Groen & Walsh, 2013).

3. INDEX OF TECHNOLOGY ENTREPRENEURSHIP DEVELOPMENT POTENTIAL (TED-pot)

Understanding the importance of technology entrepreneurship today, we decided to create a measure of potential for technology entrepreneurship development. OECD & EC-JRC (2008) published the *Handbook on Constructing Composite Indicators – Methodology and User Guide*, which provides help in creating indices. The Handbook aims to contribute to a better understanding of the complexity of composite indicators and to an improvement in the techniques currently used to build them.

The following general steps were followed in creating TED-pot:

1. Selecting the indicators that will be included in the final index,
2. Finding the right sources for collecting the data,
3. Normalizing the data, and
4. Finding the method for weighting and aggregating the selected indicators.

Steps 1 and 2: Selection of indicators and finding the right source for data collection

When deciding which indicators TED-pot should include, it was obvious that two variables must be included: one which indicates the level of ICT potential of countries, and the other which refers to the entrepreneurial potential. Analyzing the indicators measured by the *WorldBank*, we found seven potential indicators to include: ICT service exports (% of service exports, BoP), ICT goods exports (% of total goods exports, BoP), High-technology exports (% of manufactured exports), Time required to start a business (days), Start-up procedures to register a business (number), Number of new businesses registered (number), and Ease of doing business (1=most business-friendly regulations).

After collecting the data from the *WorldBank* database, indicator on high-technology exports was excluded because of a large amount of the missing values. Number of new businesses registered turned out to show

the result and not the entrepreneurial potential, so was excluded and observed as a control indicator. Ease of doing business is measured only for the two-year period (2014 and 2015), so we stayed with four indicators grouped into two pillars (variables):

1. ICT potential (ICT-pot), and
2. Entrepreneurial potential (E-pot).

In the Figure 1 we present the structure of TED-pot index, which consists of two pillars, and four indicators – two for each pillar. The links for collecting the data on these four indicators is given in the Appendix 1.

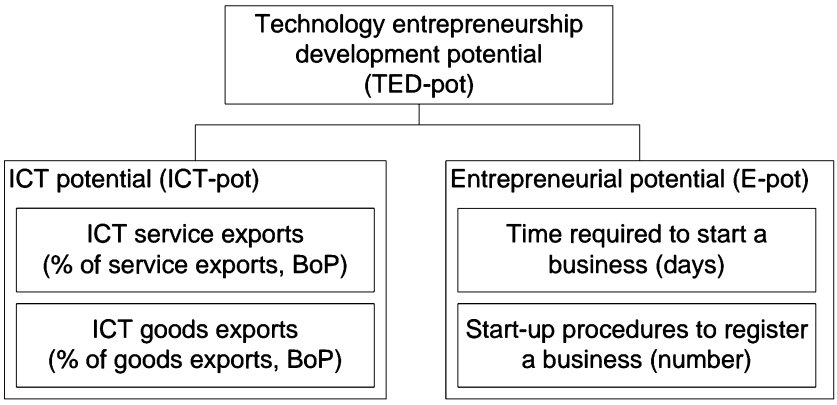


Figure 1: Structure of the TED-pot index (source: authors)

Step 3: Normalization (rescaling) of data

After deciding which indicators to include, and collecting the data, we need to re-scale the values of indicators to be suitable for aggregation. In the case of TED-pot, we observe the variables (pillars) with different natures. This means that the higher value for ICT service/goods exports, the better, but not in the case of the variables of Entrepreneurial potential where lower values show better results (it is better to have less procedures and less time needed for starting a business). This is why we needed to perform different re-scaling procedures for the two observed indicators, to make the values of indicators and the final index value positively correlated (when the values of indicators grow, also does the final index value). In the Table 1 we present the method for preparing the data for aggregation.

Table 1: Transformation of original data (normalization and preparation of data)

Pillar	Indicator	Correlation with the final index value	Normalization and preparation of the data	Correlation with the final index value after transformation
ICT potential	ICT service exports	positive	$\frac{x}{\max(x)}$	positive
	ICT goods exports	positive		positive
Entrepreneurial potential	Time to register a property	negative	$1-\frac{x}{\max(x)}$	positive
	Start-up procedures	negative		positive

As we can see from the Table, for normalization we used the max-normalization, which means that we divided the values of an indicator with the highest value for the observed year. Additionally, for the indicators of E-pot, we needed to perform one more action – subtracting the obtained value from 1 in order to make the positive correlation with the final index value. To clarify, all indicators values are now scaled from 0 to 1, where 1 is the highest value.

Step 4: Weighting and aggregation

For obtaining the final index value we used the simple weighted function with equal weights. The overall TED-pot has been built upon the equal weighting of the two mentioned pillars (ICT-pot, and E-pot), by using the following formula:

$$TEDpot = \sum_{i=1}^{2} \alpha_i P_i \quad (1)$$

where P_i represents the two pillars for each country and α_i is the constant of ½.

The value for each pillar is calculated by the same procedure used for the overall index, that is, through the simple mean of certain indicators. In total, we considered four basic indicators: two for the first pillar, and two for the second. The final TED-pot values, as well as the values for each pillar are bounded from 0 to 1.

4. STUDY ON THE POTENTIAL FOR THE DEVELOPMENT OF TECHNOLOGY ENTREPRENEURSHIP: RESULTS AND DISCUSSION

With the aim to determine whether Serbian development potential lies in the entrepreneurial IT sector, a comparative analysis was performed, which encompasses six ex-Yugoslav countries and the EU. TED-pot index, as well as ICT-pot and E-pot partially, are calculated for each country for the period 2009-2014. In the Figures 2 and 3 the results for the two pillars – ICT-pot and E-pot, are presented, respectively. The blue line shows the Serbian best value in the observed period.

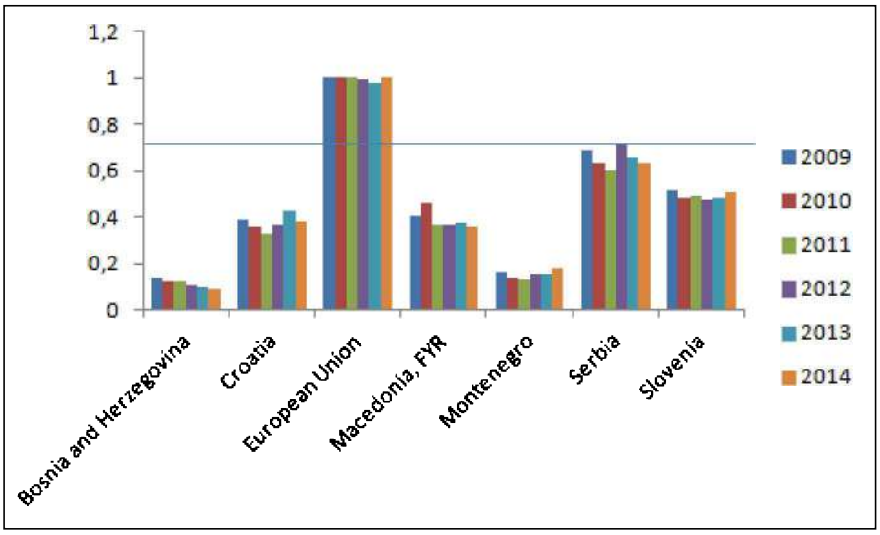


Figure 2: ICT potential (ICT-pot) - comparisons among ex-Yu countries and the EU, period 2009-2014

From the Figure 2 we can clearly see that Serbian ICT sector takes the second place with the values around 0.7 (scale 0 to 1), just behind the EU average. The EU value equals almost 1 throughout the whole time period, except for 2012 and 2013 when Serbia was above the EU average regarding ICT service exports (EU average was 35.5 and 34.59, while Serbia exported 35.87 and 35.94% of total service export). It is very interesting that regarding ICT service exports, Serbia was near the EU or above for the whole period 2009-2014. All other ex-Yugoslav countries are far behind, among which the best is Macedonia with the values around 20%. Bosnia and Herzegovina is the worst, with the values around 6%. Regarding ICT goods exports, the situation is different. The best is the EU (values around 5-6%), followed by Croatia, Slovenia and Serbia, which are intertwined throughout the observed time period (all around 1.5-2.5%). However, aggregating these values into one – the ICT-pot pillar, we can see that the EU is the best, but closely followed by Serbia, and far from the other countries which values do not exceed 0.5 (scale 0 to 1).

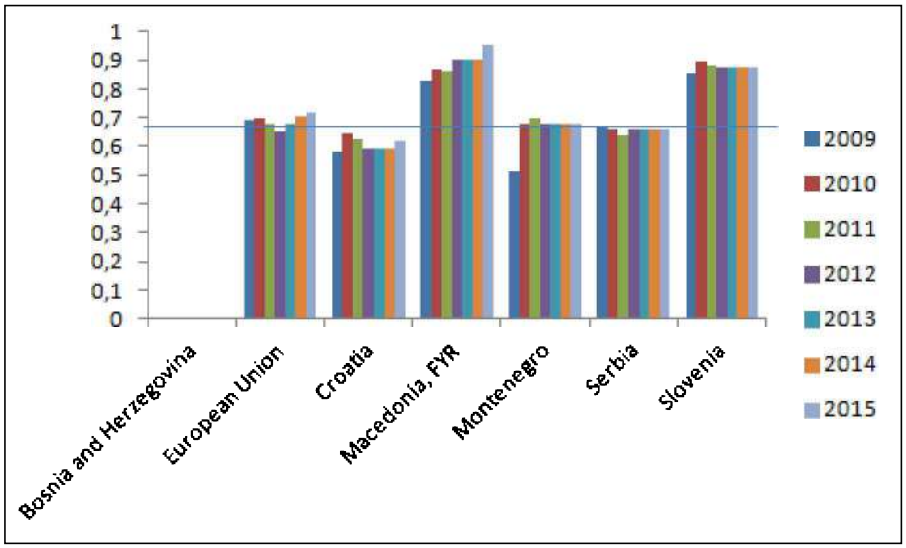


Figure 3: Entrepreneurial potential (E-pot) - comparisons among ex-Yu countries and the EU,

period 2009-2014

Figure 3 shows different results for the E-pot pillar. The EU does not have the best results. Macedonia and Slovenia, with the best (fastest) procedures for starting a business, are ranked at the top. Both the number of procedures and the time required to start a business are the lowest in Slovenia and Macedonia. Bosnia and Herzegovina are placed very low, with the values 0 for the whole time period, e.g. throughout the observed time, Bosnia and Herzegovina had the following values: 99 to 67 days for starting a business, and around 13 start-up procedures. Comparing to Macedonia, where time required to start a business is around 2-3 days, with 2-3 procedures, it is clear why Bosnia and Herzegovina has scored 0 for this pillar. Serbia, Montenegro, and Croatia have scored similar results regarding the E-pot.

Finally, the aggregated TED-pot values which indicate the potential for technology entrepreneurship development of the observed countries are presented in Figure 4. The values which are closer to 1 are better. Figure 4 clearly shows that Serbia is very near the EU average, with the highest potential for technology entrepreneurship development, far ahead of other ex-Yugoslav countries. Serbia is followed by Macedonia, Montenegro, Slovenia and Croatia which have close final values. Bosnia and Herzegovina are at the back of the list, with the final value of around 0.35 (value for Serbia in 2012 is around 0.8 on the scale 0 to 1). The values for the EU are slightly above 0.8 for the whole period (except 2009).

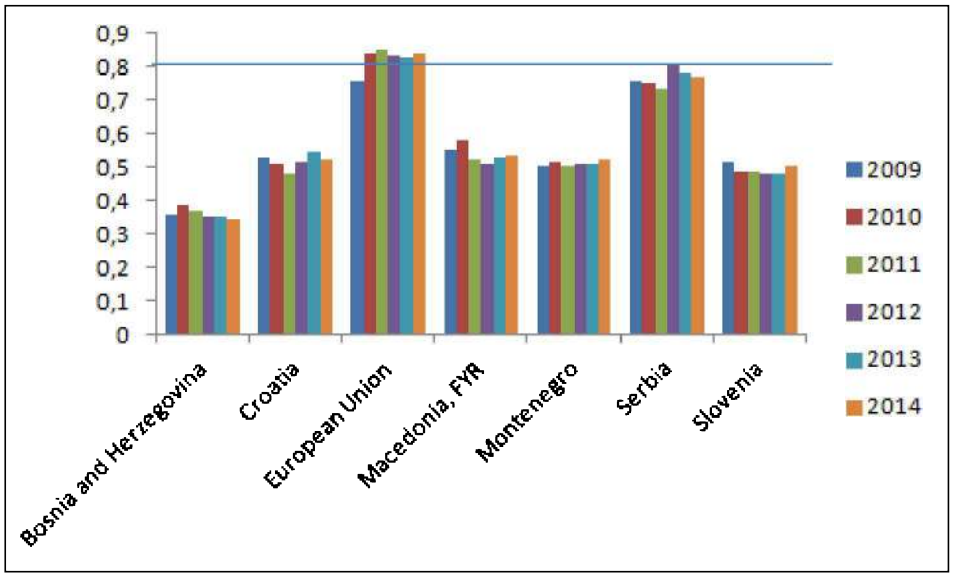


Figure 4: Technology Entrepreneurship Development Potential (TED-pot) - comparisons between ex-Yu countries and the EU, period 2009-2014

These results indicate that the potential of Serbian development lies in its entrepreneurial ICT sector. In order to really further step up this result, the state has to increase investment into research and development and science which nowadays stand at 0.3% of GDP (the EU average is around 2%). Serbia, which shows remarkable results in ICT exports, is currently investing only €60 per capita into the development of the ICT industry, far less than e.g. Croatia (€200). The EU average is €800 (SIEPA, 2015). Since ICT is considered as priority sector for the Government (MESTD, 2016), they should increase the support for this sector over the years, especially since the sector gives strong results in attracting investors and employment. One thing that proves that Serbia is on the right track is opening of the ICT hub for technology entrepreneurship in the science park Zvezdara (in 2014), as well as the Startit centres in Belgrade (in 2015) and Indjija (in 2016).These are incubators which are intended for fostering technology start-ups. Besides these, the well-known Business Technology Incubator of Technical Sciences (BITF) already fosters 53 start-ups, which developed 45 innovations, among which 10 are patented (data available on the official web-site of BITF).

5. CONCLUSION

The objective of this paper was to examine whether the Serbian development potential lies in technology entrepreneurship. In other words, we wanted to confirm the hypothesis that technology entrepreneurship is the focal development strategy for Serbia. For that purpose, we developed an index of Technology Entrepreneurship Development Potential (TED-pot) which has two pillars: ICT-potential (ICT-pot) and Entrepreneurial potential (E-pot). These pillars include two indicators each: ICT goods and ICT service exports (for the first pillar), and Time required to start a business and Start-up procedures (for the second). All the data is collected from the *WorldBank* database. The methodology for construction of TED-pot is explained in Section 3. The index was applied on a set of six ex-Yugoslav countries and the EU, for the period 2009-2014. The detailed results and discussion are presented in Section 4. To summarize, the

calculated values show that Serbia has the best potential for technology entrepreneurship development in the region, being closely behind the EU (e.g. value of TED-pot for Serbia in 2012 is 0.808, while for the EU this value equals 0.835; scale 0 to 1). Although Serbia does not have the best E-pot value in the region, based on the fact that the procedures and time required to start a business are not the lowest, it still has a fertile ICT sector which compensates the slightly lower E-pot value. It should be noted that it is in the best tradition of the history of technology in Serbia since the first digital computer in Central Europe was manufactured in Serbia back in 1960. At the time, Serbia was also one of the six countries in the world with the capability and know-how needed to do that (SIEPA, 2015). Summing up the results of TED-pot index, it could be concluded that Serbian potential is in the development of technology start-ups which could further grow and become the back-bone of Serbian economy.

Since, to the best of our knowledge, this is the first attempt of measuring potential for the development of technology entrepreneurship at country level, there are at least three obvious limitations of this paper which could be discussed. The first is the selection of indicators which are included in the TED-pot index. The second is the methodology used for constructing TED-pot (normalization of data, weighting and aggregation scheme). The third limitation is the narrow analysis, since it included only six ex-Yugoslav countries and the EU average, and should be broadened to a larger set of countries in order to validate the index results, which could be performed by comparing and connecting TED-pot values with the established values such as Ease of doing business, ICT development index, Technology readiness etc. The results could be validated only on a larger sample of countries. The future research directions are found to be: 1. revising of included indicators (considering including a larger set of indicators), 2. revising of the methodology used for obtaining the final value (considering different normalization techniques, as well as weighting and aggregation schemes), 3. broadening the analysis worldwide and enabling the global cross-country comparison, and 4. adding the third pillar - sustainability, with the aim to create a measure of the potential for sustainable technology entrepreneurship development.

REFERENCES

Bailetti, T. (2012). Technology entrepreneurship: overview, definition, and distinctive aspects. *Technology Innovation Management Review*, *2*(2), 5.

Byers, T.H., Dorf, R.C., & Nelson., A.J. (2011). *Technology Ventures: From Idea to Enterprise*, 3rd Ed., International Ed., McGraw Hill.

Centar za Visoke Ekonomske Studije – CEVES (2014). *Entrepreneurship in Serbia – A Necessity or an Opportunity?*, CEVES, Belgrade. Retrieved from: http://ceves.org.rs/wp-content/uploads/2014/02/Preduzetnistvo-u-Srbiji.pdf

Etlie, J. E. (2000). *Managing Technological Innovation*, John Wiley&Sons.

Gilsing, V. A., Van Burg, E., & Romme, A. G. L. (2010). Policy principles for the creation and success of corporate and academic spin-offs. *Technovation*, 30(1), 12-23.

Groen, A.J., & Walsh, S.T. (2013) World Problems – Emerging Technologies: Introduction to the Field of Creative Enterprise. *Technological Forecasting and Social Change*, 80, 187–90.

Harms, R., & Walsh, S. T. (2015). An Introduction to the Field of Technology Entrepreneurship: Editorial to the Special Issue. *Creativity and Innovation Management*, *24*(4), 552-557.

Levi Jakšić, M., Marinković, S., & Petković, J., (2010, June). Managing technology entrepreneurship competences, Proceedings of *SymOrg 2010 – "Organizational Sciences and Knowledge Management"*, FOS, Belgrade.

Ministry of Education, Science and Technological Development – MESTD (2016). *Strategy for scientific and technological development of the republic of Serbia for the period 2016-2020 – "Research for innovation"*, Government of the Republic of Serbia. Retrieved from: http://www.mpn.gov.rs/wp-content/uploads/2015/08/STRATEGIJA-naucnog-i-tehnoloskog-razvoja-RS-za-period-2016-2020..pdf

OECD, & European Commission-Joint Research Centre. (2008). *Handbook on constructing composite indicators: Methodology and User guide*. OECD publishing.

Serbian Investment and Export Promotion Agency – SIEPA (2015). *Serbia Smart Solutions – ICT Sector. SIEPA, Belgrade*. Retrieved from: http://ras.gov.rs/uploads/2016/02/ict-industry-in-serbia.pdf

APPENDIX 1

Table: Links used for collecting the data:

Indicator	Link
ICT service exports (% of service exports, BoP)	http://data.worldbank.org/indicator/BX.GSR.CCIS.ZS
ICT goods exports (% of total goods exports)	http://data.worldbank.org/indicator/TX.VAL.ICTG.ZS.UN
Time required to start a business (days)	http://data.worldbank.org/indicator/IC.REG.DURS
Start-up procedures to register a business (number)	http://data.worldbank.org/indicator/IC.REG.PROC

USE OF MODERN TECHNOLOGY IN HOTEL ORGANISATION: THE INFLUENCE OF INFORMATION TECHNOLOGY ON HUMAN FACTOR

Olga Jovanović*[1], Gheorghe Savoiu[2],
[1]*Euro Fineks Broker,
[2]University Of Pitesti
*Corresponding author, e-mail: olgacobasjovanovic@gmail.com

Abstract: *Technological innovation is one of the most important factors in business in today's market. The most important factor in hotel business is human factor, since it is service-oriented industry but it must include use of technology to survive and have success at today's competitive market.*
The subject of this research is literature review and analysis of the concept of technology use in hotel business, and its effect on human factor.
The aim of this research is to analyze use of modern technology in hotel business, guests' and employees' satisfaction with them, their motivation and willingness to use them.
It is assumed, that the use of technology has positive influence on hotel service, but only as a way of making better service provided by employees (assuming that they are trained and motivated to use it) and that technology cannot and should not replace human factor in hotel industry.

Keywords*: hotel industry, modern technology, human factor, guest satisfaction and employee motivation*

1. INTRODUCTION

Hotel industry, like other business-oriented organizations exists on market that represents a place of demand and offer, where sellers and buyers meet and where an object of exchange must exist (a product or service) (Popesku, 2013). Hotel industry is service-oriented and operates on the market of services; therefore, the most important factor is to provide the best service. The value of services or products depends on many factors such are social, economic, hedonistic, etc. (Popesku, 2013).
Services are valued by specific characteristics that differ from products. Intangibility, creation and use of services in the same time - simultaneously, are two characteristics where human factor is very important, because human is providing services and using it. There must be an understanding between provider and user of service, because the buyer or user of services is at the same time responsible for the creation of services (Popesku, 2013).
Another important factor is specifics of touristic need that represents added value and not the basic need. The way in which the service is provided to consumer is important, in order to be satisfied. Human factor is important for the creation of service because one of the service characteristics is that consumers must meet people who provide them service in order to consume the service. Human resources and potential are the most important factor of the organization because using their knowledge, skills, abilities and competencies can contribute to the success of the organization (Dessler, 2013). However, technological changes have brought innovations in the way of providing services in all sectors, and are an important competitive factor.
Organization of hotel business is very specific. Since the consumer segment is constantly changing as trends change, hotel managers need to change and upgrade services they offer to potential guests in order to survive on the market, since without profitable customers it is not possible (Jaško et al., 2013). Hotel managers are also trying to design a business model that will adapt to new needs of consumers of service. It includes use of modern technology. According to research conducted in the USA in 2015, based on a random sample of 3.103 respondents, 60% of potential clients would prefer to stay in a hotel that has technology that allows hotel check in and entering the room by using a smart phone (Softveradvice, 2015).

2. HOTEL BUSINESS ORGANISATION

Very important factor in the hotel industry is the relationship with the customer and guest experience. Since the decision-making process in the tourism industry is led by hedonistic and emotional factors, most users choose travel destination and hotels based on emotions, fantasy and personal preferences (Štiklica, 2015). Modern hotels are organized, and divided by functions and departments. According to the European hotel standards, they can be classified into five categories. Based on Štiklicas research (2015), guests are

impressed mostly, by the hotel design and decoration, and that is the first thing that attracts them when they enter the hotel. Technical possibilities of the hotel are at the lowest level. According to research by Rauch, Collins, Nale and Barr (2015), environment where services are provided is more important in the medium category hotels (3 *), than a way service is provided or if there technological capabilities exist that would improve service. However, if the technology is used to increase the diversity of products, and basic hotel services (for example, self-service kiosks for check-in), guests think that it improves the quality of overall service.

Since the last economic crisis that affected hotel industry, as well, managers are constantly trying new ways to attract new guests and retain old ones. Use of technology in hotels may represent a successful strategy for creating a competitive advantage. Increased use of social networks and the Internet made more information available for hotel managers' research, especially in the design of strategies for the hotel business (Koutroumanis, 2011). Online booking systems such are Booking.com, Venere.com, Airbnb and many others are unavoidable strategic methods of modern hotels. Most hotels have variety of programs that allow them access to databases of the guests. Employees, though, must be taught and interested in using such technology and understand it, so they can use it to improve services. Since there are new trends and changes in hotel organization and use of technology, a strategy for organization change of human factor must be created also, since human factor is the most important in hotel industry (Ko, Pei, and Tsai, 2016). Hotel managers' focus is on guest satisfaction with use of technology innovations. Since employees are the ones using technology in every day work, it should become the focus as well, because if the employees are not motivated, educated and interested to use it there will be no successful implementation (Ko, Pei, and Tsai, 2016).

3. TECHNOLOGICAL INNOVATIONS IN HOTELS

Since the 80s, information technology is included and used in changing tourism and hotel business and as part of its strategy (Buhalis and Law, 2008), as it influence strategic management orientations (Čudanov and Jaško, 2012). Nowadays, tourist and guests are mostly well technologically educated, work in multicultural environments, have wider choice of services, and thus a wider range of demands. Technology progress has brought the chance for tourists to choose by themselves set of services and destinations through internet, and to choose package tours, less. Tourists are less tolerable for waiting, queues, and cancellations. They demand from service providers to be quick in recognizing, and satisfying their needs (Buhalis and Law, 2008).

According to Softver advice (2015), on average 13% of smart phone owners would prefer to make a reservation in a hotel through some application, 37% would prefer to choose a hotel with lobby that offers some kind of modern technology, like touch screen, or self-service kiosk to check in, 41% would prefer face recognition hotel that recognizes guest and personalizes the service. It is shown that use of modern technology in that way would cut costs for 50%. This research should be taken with caution because it is done on small sample of American population and it is biased because it is conducted by Softver Company. Touch screen, face recognition, and smart phones used to check in and entering the room instead of key, are some of technological innovations that are used mostly in USA, so far, but are planned to apply in hotel chains around the world. Making a reservation through mobile application is new channel of sale in hotel business. In some hotels, there is even option to use smart watches for check in and room entering instead of key card. Use of interactive mobile technology have made providing of some services in hotels easier. For the guests it is easier to order food, find needed information about destination they are at, and in that way they make it easier also for the employees, they do not have to ask lot of questions receptionist for example.

Guests as well as employees, who are more open, curious, and interested in games, are more likely to use mobile technology in hotel (Zhu and Morosan, 2014). Off course, in order to use these applications in hotel, employees are first who must be completely familiar with the concept and how to use it. If employees are interested and use technology often, their smart phones, and applications, they will be more motivated to use it as a tool for work and they would be satisfied because it makes their work easier (Zhu and Morosan, 2014). Big hotel chains have their human resource departments research motivation and satisfaction of employees with using technology in work, and create strategies accordingly.

However, the question is whether technology can replace human factor and to what extent it would be necessary to achieve success in hotel business."Savioke" company that specializes in robotics, invented a butler robot in 2014. that is designed to take small object (toothpaste and razor) to guests. According to their research, 56% of guests were interested in this service before the use, and after using it higher percent of guests were indifferent. According to research of Softver advice (2015), "millennia's" generation is a consumer segment that should be in focus of hotel managers, when introducing new technologies, while if they want to attract the older generation, it is not necessary to introduce many technological innovations.

Improtant factor when planning the use of modern technology, and to what extent as a tool for work, is setting goals that hotel wants to achieve. Indentifying the position of hotel in the moment of planning, setting clear objectives, and appropriate strategy, as well as the mission and vision of the hotel, will increase success (Dessler, 2013). Use of modern technology depends on guests that hotel wants to attract, but on

the structure of employees as well. It is more likely that guests, who share same values on the terms of culture, tradition, and use of technology as employees, will be attracted to come to the hotel.
Information technology in hotel business that is used appropriately has contributed to improving service quality, communication and cost reduction. In some hotels where employees and guests are not ready to use it, it may represent a problem or even cause dissatisfaction (Lam, Cho and Qu, 2007).

3.1. Information systems in hotel industry

There are three phases of the implementation of information systems in hotel, such as: accounting phase (accounting, marketing and billing), administrative phase (reservations, reception, reports) and tactical phase (technology, security, security systems) (Radaš, 2015).
Technology development created database that can be a base for carrying out a lot of research and analysis, with the aim of improving and enhancing services and relationship with guests (Kuzmanovic, 2013). Databases are important because of the data organization, consistency, and longer period of storage, multidimensionality and web-design. They are used to collect data about guests, and enable measuring the results achieved, more accurately. Big data, as modern concept, represent enormous database that is important for hotel managers to analyze and use data easier and satisfy guests. It can be used through on line reservation system, but it should be carefully used to get correct and precise data.
There are information systems for operational support (systems for transaction processing - Transaction Processing Systems) intellectual work support (systems for professional support - Professional Supporting Systems, Office System - Office Information Systems and Knowledge Management Systems) and for management support (score cards, balance card) (Kuzmanovic, 2013). In hotel industry usually CRS (Computer Reservation Systems), PMS (Property Management System) and CRM (Customer Relationship Management) systems are used, and every hotel uses some customized software for work. All hotel information systems (HIS) are designed to facilitate the work of employees and reduce their time of collecting, processing and analyzing data, provided that employees know to use them (He, Kyung, Kim and Moon, 2015). The work is made easier for all employees in the marketing, reservations and reception department. Their work is made easier because they can store all the information in computer and can find information easier by typing certain parameter in the search program. There are programs and applications that can help receptionist remember some reservations and remarks, helping to avoid possible errors (Hotelier - reservation softver, for example).

3.2. Intelligent room

Modern technology in hotels is also used through system of intelligent rooms. Significant services are: improving surveillance and warning - SOS alarm, control the temperature in the room, monitoring the status of the guest, which serves to provide the information that guest is in the room, whether he wants or does not want to be disturbed, access control and payment - payment by credit card, the card to unlock the room instead of a key, which also serve to turn the electricity in the room – electricity savings (Kuzmanovic, 2013).
Some systems are designed to facilitate services to guests while some are designed to facilitate the work of employees. Time and space solutions for time and attendance evidence, and access control systems are simple systems for employees, enabling hotel manager to control work easier (Spica, 2016). The systems do not require special training and are easy to use. Managers can easily review the working hours of employees, and receptionists use it to know the position of everyone. For example, if an error occurred while marking the availability of rooms for cleaning, to prevent entry into the room if a guest is in the room and thus avoid unpleasant situations and error employees. The system provides a pleasant environment, a better insight into the business organization, better coordination of activities and faster adjustment to modern requirements (Spica, 2016). Electronic locks provide more security and control, and maintenance and thus facilitate the work of employees (house cleaners, technical maintenance, reception, managers) and requires no special training other than in the implementation of these solutions.

3.3. Self-service technology

At first people were skeptical and reluctant to use self-service technology but eventually got used to this type of service. If a guest or an employee had a satisfying experience when using self-service technology, or heard of one's experience, he is more likely to use it again (Meutera, Ostromb, Bitnerb and Roundtreec, 2003). When guests plan a trip and want to spend less money, they are more likely to use Internet and technology, but when they want reliable and safe service, they opt for the human factor (Cheyne, Downes and Legg, 2006). Customers should have a choice to use the service in a way that will best meet their needs. Self-service technology is used increasingly in hotels and is subject of various research. It is mainly used as a substitute of human factor or as an addition to existing services. The opinions of managers on the introduction of this type of technology diverge - on the one hand, fear that by replacing human they will lose guests who prefer interaction, on the other hand is an opportunity for cost reduction and improvement of

services (Haemoon, Miyoung and Seyhmus, 2013). The advantage of self-service technology use is time saving. How the habits of people are changing, in some areas they do not have the need for personal contact, so the human factor can be replaced by technology and thus reduce the cost of the hotel. Waiting lines in the lobby or restaurant makes negative overall impression of hotel, especially when it is first encounter in the hotel. The use of self-service technology brings guests a choice how they want to use the service. They can get service the traditional way where the human factor is involved or with the help of technology (Kokkinou and Cranage, 2013). According to Kokkinou and Cranage (2013) if there is no crowd or queue for check-in at the reception with employees and at the same time self-service kiosk is available, 25.08% of guests would choose kiosk. 90% of guests consider the expected waiting time of 120 seconds, after which the queue provokes discontent. Employees can help to encourage travelers and guests to use the machines to save time.

3.4. Shortcomings and problems using information systems

The advantage of information systems and modern technology are great, but there are also disadvantages and threats that affect the quality of services. About 55% of attacks on credit card took place in the hotel business. There are threats in terms of data theft, security breaches of data and information. The hotel industry is the most interesting to hackers because of the low level of system security. In order to protect information systems, ISO standards for safety are introduced, and many programs for risk assessment (Njeguš, Grubor and Vejnović, 2013).

As an important factor in preventing fraud and theft in the hotel industry, the use of biometric measures is recommended, such as using a fingerprint or voice, instead of cards or phone identification (Jungsun and Bo, 2014). To avoid a problem during work and use of modern technology as much as possible, the appropriate training of employees is required, that would include the IT team that implements new technology in the hotel, as well.

If it is made easier and faster for employees to learn how to apply the technology, and improving the visibility of some of the services in the application of technology, the greater the motivation and interest in using the same would be (Lam, Cho and Qu, 2007). Hotels that are using technology largely, have to educate also those who are dealing with the information technology, as well as employees that are going to use it, in order to improve the service. The IT team is specialized to understand computers, not people, and guests. If they would have a better understanding of end services, maybe would be able to improve their service. It would be good if they were also engaged in training programs for other employees that are directly related to guests (Nedry, 2015).

4. HUMAN FACTOR IN HOTELS

4.1. The importance of the human factor

The human factor cannot be replaced completely because human resources are the ones who create and influence economic efficiency of the organization, create products or services, control quality, place them and determine the overall strategy of the organization (Kuzmanovic, 2013). Corporate culture in organizations including hotels, affects the success and competitiveness of the organization. If employees are satisfied, motivated to work and are success-oriented it is more likely that the hotel will be more successful (Sawalha, Zaitouni and Elsharif., 2012).

According to Kokkinou and Cranage (2013), if self-service kiosk is used in the hotel, check-in waiting lines would reduce and the quality of services would improve, but only when there are employees at the reception. If the self-service kiosk is used to replace an employee completely, the business would remain at the same level. It would not reduce the cost of doing business as assumed. Of course, employees must be adequately trained to use self-service kiosk, otherwise waiting lines could be bigger. According to Haemoon, Miyoung and Seyhmus (2013), it is desirable to add a self-service kiosks and modern technology in hotels in tourist resorts, to help employees to provide services, but guests still want to interact with employees.

The technology, on one hand provides privacy, autonomy and effective service, but on the other side does not meet the emotional need of guests. The essential role of the human factor is empathy and understanding. When guests are dissatisfied with the service, they can complain to the employee, not to the machine. Employees can have better understanding of their need, understand how they feel, whether they are angry, nervous, happy, and what kind of services can be provided, accordingly. If guests have built trust and relationship with employees, they are more likely to come back to the hotel.

4.2. The influence of information systems on human factor

How successful implementation of technology in the hotel will be, depends on the willingness of employees to use it. Since its use is very important competitive factor (He, Kyung, Kim and Moon, 2015), employees and management of the hotel are aware that it is necessary to use it, but there are often problems when it is applied. The willingness and interest of employees for the use of modern technology in the hotel depends on

the willingness and beliefs about the usefulness of the use of information technology in general (Ko, Pei and Tsai, 2016). Ko, Pei and Tsai (2016) showed in their research that if there is a positive attitude about the use of information technology, there would be greater intention and readiness for its use in the service process. According to He, Kyung, Kim and Moon, hotel information systems facilitate employees work in different ways and they are satisfied with this way of work (2015). "The technology increases the quality of service, reduce operational costs, reduce routine and repetitive tasks for employees and creates the possibility that employees focus on creating ideas and innovation, and to provide quality customer service" (Andjelkovic, 2008, p. 166).

However, despite the readiness and motivation to use information technology in the work, there must be knowledge and expertise to use it, adequately. It is believed that it is best that managers or people in the hotel that are considered the most important people in the hotel, assist and encourage employees to use modern technology in the hotel (Ko, Pei and Tsai, 2016). In addition to the IT team that carried out the implementation of new technologies in the hotel, managers have operative knowledge and support employees. The employees will then transfer the knowledge and assist guests.

Hotel organizations have to change if technological changes are introduced, as ICT gives strategic influence on organization (Čudanov, 2011). Hotel managers must choose and employ personnel who is technologically competent and is able to understand the training program that involves the use of technology. Besides current knowledge and skills required for employment, receptionists, managers and heads of some departments in the hotel (language skills, teamwork, communication skills, education background, analytical skills, ability to evaluate ...) (Kosar, 2002) new skills has to be sought as well as the knowledge of technology basics.

It is necessary that most employees know how to use all devices and technologies that the hotel has implemented. If potential employees do not have experience in use of systems and programs of the hotel, it is necessary to have basics, so to be able to adapt quickly to new conditions and technologies, as openness presents important factor in company's growth (Jeraj, Marič, Todorović, Čudanov and Komazec, 2015). Various studies on the employees willingness and self-efficacy to use technology in work have shown that the majority of employees are willing and interested to use it, and feel that it makes it easier to work (Ko, He, Law).

Very important factor in the service industry is educated and professional staff. Many hotels create their training programs that will meet the needs for certain positions they need. Particularly significant is investment in staff that have the knowledge, not only professional, but also about the behavior of customers. The continuous process of education, gaining experience, and development of interpersonal relationships is desirable in learning organizations. It enables employee to prepare for future jobs. Training is for the employee to train for the current job, and development is for the future (Noe, Hollenbeck, Gerhart and Wright, 2012).

5. CONCLUSION

The use of modern technology in addition to the human factor is emerging strategy that can improve the quality of services. Fifteen years ago, and more attention was paid to the price of computers and technology, that was used in the hotel. Today when almost every hotel has available technology at affordable prices, focus is shifting to human resources who are using it. Focus is shifted to finding the most efficient way to achieve the best combination of cost of purchase and use of the technology, and the training and motivation of employees to use it. When applying technology, first consumer segment should be determined and in line with that, use modern technology to a greater or lesser extent.

Since guests are driven by emotions when choosing the hotel, very important factor is relationship that they established with employees. As long as the role of information systems and modern technology is to improve service, increase business productivity, quality and way of communication to a higher quality level (not at any price and to reduce costs), it can bring a competitive advantage (Kuzmanovic, 2013). There is a consumer segment, which would be interested in fully automated hotel, but so far, there are no relevant data to show.

Hotel can achieve success if it is able to combine modern technology as an aid and in accordance with the human factor, and not to replace human entirely. Hotel can achieve success if combines modern technology with the human factor that is motivated and qualified to use it. If some of these factors lack in hotel business strategy, it is more likely that the strategy will not achieve expected success.

Tradition, and its preservation together with technology in modern tourism are some of the most intensely debated issues in many researches dedicated to tourism management and marketing policies in general (Goeldner, Ritchie and Mcintosh, 2000). Traditionalism, as a tourist aspect that has acquired some distinctive components, recognized in the specificity of human factor, and especially in hotels services and in the specific cuisine, once coming on a collision course with the technology risks generates a real deterioration of the potential in any kind of the tourism activity. Thus, the general equilibrium defined by the balance between the human resources tradition and modern technology could be sought and found even in the contemporary hotel organization.

REFERENCES

Anđelković, M. (2008). Uticaj informacionih tehnologija na uslužni sektor. *Škola biznisa* 1, 162-167

Buhalis, D., Law, R. (2008). Progress in information technology and tourism management: 20 years on and 10 years after the Internet – The state of eTourism research. *Tourism Management, 29*, 609-623. doi:10.1016/j.tourman.2008.01.005

Cheyne, J., Downes, M., Legg, S. (2006). Travel agent vs Internet : what influences travel consumer choices?. *Journal of Vacation Marketing, 12*(1), 41. doi: 10.1177/1356766706059307

Čudanov M., Jaško O. (2012). Adoption of Information and Communication Technologies and Dominant Management Orientation in Organizations. *Behaviour & Information Technology,* 31 (5). pp. 509-523, DOI:10.1080/0144929X.2010.499520

Čudanov, M. (2011). Organizacija i strateška primena IKT-a, Beograd, Srbija: Zadužbina Andrejević.

Dessler, G. (2013). Human resource management, 13th edition. Pearson, USA: Florida International University.

Gelderman, C., Ghijsen, P., Diemen R. (2011). Choosing self-service technologies or interpersonal services-The impact of situational factors and technology related attitudes. *Journal of Retailing and Consumer Services, 12*, 414-421. doi:10.1016/j.jretconser.2011.06.003

Goeldner, C.R., Ritchie, J.R.B. & McIntosh, R.W., (2000). Tourism: Principles, Practices, Philosophies. 8th ed. New York,USA: John Wiley and Sons.

Guest preferences for technology use in hotels (2015). Industry view. Retrieved from http://www.softwareadvice.com/hotel-management/industryview/technology-use-report-2015/

Haemoon, O., Miyoung, J., Seyhmus, B. (2013). Tourist adaptation of self-service technologies at resort hotels. *Journal of Business Research, 66,* 692-699. doi:10.1016/j.jbusres.2011.09.005

He, Z., Kyung, H., Kim, J., Moon, Y. (2015). A study on the effect of hotel intelligent fusion system on hotel strategy, work process, employee satisfaction, and hotel performance. Springer. *Multimedia Tools Appl, 74,* 3377-3385. doi: 10.1007/s11042-014-2011-5

Jaško, O., Čudanov, M., Jevtić M, Krivokapić J (2013). Osnovi organizacije i menadžmenta, Beograd, Srbija, Fakultet organizacionih nauka

Jungsun, S. K., Bo, B. (2014). Factors influencing hotel customers intention to use a fingerprint system. *Journal of Hospitality and Tourism Technology*, *5*(2), 98-125. doi: 10.1108/JHTT-11-2013-0031

Jeraj, M., Marič, M., Todorović, I., Čudanov, M. & Komazec, S. (2015). The Role of Openness and Entrepreneurial Curiosity in Company's Growth. Amfiteatru Economic Journal, XVII(38). (ISSN 1582-9146).

Ko, C., Pei, L., & Tsai, Y. (2016). A study of employees' perception of information technology adoption in hotels. *International Journal of Organizational Innovation (Online), 8*(3), 231-238. Retrieved from http://search.proquest.com.ezproxy.rit.edu/docview/1762303132?accountid=108

Koutroumanis, D. A. (2011). Technology's effect on hotels and restaurants: Building a strategic competitive advantage. *Journal of Applied Business and Economics, 12*(1), 72-80. Retrieved from http://search.proquest.com.ezproxy.rit.edu/docview/866754216?accountid=108

Kokkinou, A., Cranage, D. A. (2013). Using self-service technology to reduce customer waiting times. *International Journal of Hospitality Management*, 33, 435-445. Retrieved from http://dx.doi.org/10.1016/j.ijhm.2012.11.003

Kosar, Lj. (2002). Hotelijerstvo: teorija i praksa. Viša hotelijerska poslovna škola, Beograd

Kuzmanović, A. (2013). *Ljudski resursi kao faktor uspeha u hotelskom poslovanju* (Master rad). Univerzitet Singidunum, Beograd

Lam, T., Cho, V., Qu, H.(2007). A study of hotel employee behavioral intentions towards adoption of information technology. *Hospitality management, 26*, 49-65. doi:10.1016/j.ijhm.2005.09.002

Meutera, M. L., Ostromb, L.A., Bitnerb, M. J., Roundtreec, R. (2003). The influence of technology anxiety on consumer use and experiences with self-service technologies. *Journal of Business Research, 56*, 899-906. doi:10.1016/S0148-2963(01)00276-4

Nedry, R. (2016). The IT Factor in Service. How does the Information Technology team fit into todays guest experience.Hotelexecutive.com. Retrieved from http://hotelexecutive.com/business_review/3029/the-it-factor-in-servicehow-does-the-information-technology-team-fit-into-todays-guest-experience

Njeguš, A., Grubor, G., Veinović M. (2013). Uticaj i bezbednost informacionih sistema na kvalitet usluga (IX Međunarodni naučno-stručni simpozijum). Poslovno udruženje hotelsko ugostiteljske privrede Srbije – HORES, Beograd. Retrieved from http://www.hores.rs/docs/hotel_kuca2013.pdf

Noe, R., Hollenbeck, J., Gerhart, B., Wright, P. (2012). Human resource management: gaining a competitive advantage, 3rd edition. New York, USA: McGraw-Hill Education

Popesku, J. (2013). Marketing u turizmu i hotelijerstvu. Univerzitet Singidunum, Beograd. Retrieved from file:///C:/Documents%20and%20Settings/Administrator/My%20Documents/Downloads/US%20-%20Marketing%20u%20turizmu%20i%20hotelijerstvu%20(1).pdf

Radaš, F. (2015). *Analiza uticaja savremenih informacionih sistema na hotelsko poslovanje* (Master rad). Univerzitet Singidunum, Beograd

Rauch, D. A., Collins, M. D., Nale, R. D., & Barr, P. B. (2015). Measuring service quality in mid-scale hotels. *International Journal of Contemporary Hospitality Management, 27*(1), 87. Retrieved from http://search.proquest.com.ezproxy.rit.edu/docview/1652621825?accountid=108

Sawalha, N., Zaitouni, M., Elsharif, A. (2012). Corporate culture dimensions associated with organizational commitment: an empirical study. *Journal of Applied Business Research*,28(5) Retrieved from file:///C:/Documents%20and%20Settings/Administrator/My%20Documents/Downloads/7237-28888-1-PB.pdf

Spica (2016). Hotelski sistemi. Retrieved from http://www.spica.rs/resenja/hotelski-sistemi

Štiklica, M. (2015). Dizajn strategija hotela kao rezultat potreba korisnika (Doktorska disertacija). Fakultet tehničkih nauka, Departman za arhitekturu i urbanizam, Novi Sad.

The value of robotic room service (2014). Industry view. Retrieved from http://www.softwareadvice.com/hotel-management/industryview/robotic-service-report-2014/

Zhu, W.W., Morosan, C. (2014). An empirical examination of guests' adoption of interactive mobile technologies in hotels. *Journal of hospitality and tourism technology, 5*(1). DOI 10.1108/JHTT-09-2013-0029

POTENTIAL IMPACT OF 3D PRINTING IN REDESIGNING SUPPLY CHAIN – EXAMPLE OF MEDICAL INDUSTRY

Bogdan Rakić[1]*, Aleksandra Ratković[1], Jovana Mrvić[1]
[1]Faculty of Organizational Sciences
*Corresponding author, e-mail: fon.bogdan@gmail.com

Abstract: *This paper covers the globally recognized topic of additive manufacturing. The document examines in particular its impact on supply chain and how medical industry benefits from it. In addition, research of the development of this field in Serbia has been conducted with recent findings. Interviews with the people in this industry in Serbia have been the backbone of the research. Paper combines theoretical knowledge and practical views presented from world's leading business thinking centers. The aim of this paper is to give a contribution in revealing the possibilities 3D printing provides and to highlight its impact in medical industry in Serbia and worldwide.*

Keywords*: 3D printing, additive manufacturing, medicine, supply chain, supply chain management*

1. INTRODUCTION

Supply chain management is of great importance for everyday functioning of organizations. A large amount of resources is invested into managing it effectively and efficiently. Numerous hours of labor and significant investments in equipment, machines, software and personnel training is what accompanies today's supply chain management. An example of traditional model of manufacturing supply chain is showed below:

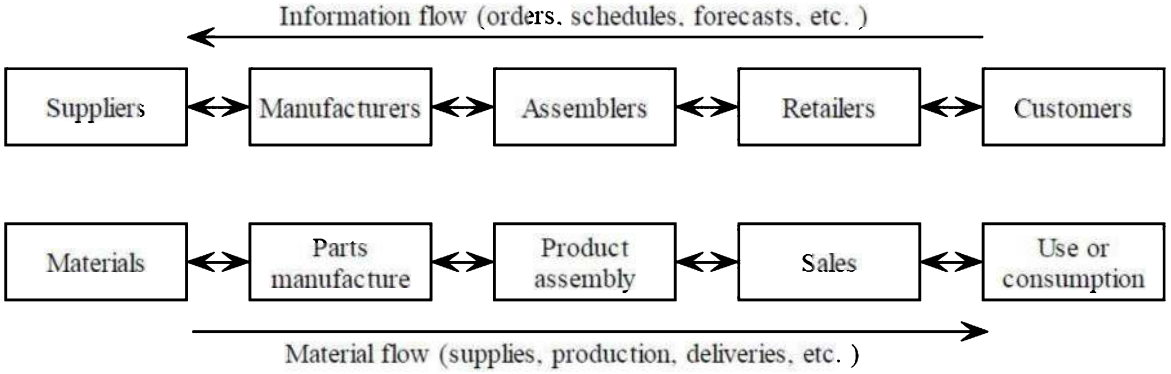


Figure 1: Generic configuration of a supply chain in manufacturing (Vrijhoef & Koskela, 2000)

This configuration shows the checkpoints in the process of serving customers. All those checkpoints are interconnected with a number of support functions and processes. Some of the biggest cost drivers are transport, IT support, quality control, etc. It is the purpose of supply chain management to conduct all of those in a proper ways, with reasonable cost on one side, and satisfied market demands and customer needs on the other. The scope of roles supply chain management varies in size, but either way, its functioning is essential for the success of an organization.(Mentzer et al., 2001)

2. EVALUATION OF SUPPLY CHAIN

Companies continually monitor the performance of their supply chain. Some industries have their own peculiarities and require very specific measures, but the core idea behind the supply chain management metrics is the same. Some of the key metrics are presented by (Gunasekaran, 2004) and could be divided in several areas:

Metrics for order planning;

- Order lead time (time elapsed between the receipt of the order until the delivery of the finished goods to the customer)

- The customer lead path (a path that an order traverses and the time spent in different channels)

Evaluation of supply link:
- Evaluation of suppliers (efficiency, flow, integration, responsiveness)
- Strategic level measures (lead time against industry norm, supplier pricing against the market)
- Tactical level measures (efficiency of purchase order cycle time, cash flow, quality assurance, capacity flexibility)
- Operational level measures (adherence to developed schedule, avoiding defects)

Metrics at production level:
- Range of products and services
- Capacity utilization

Evaluation of delivery link:
- Average cost per delivery
- Flexibility of delivery systems to meet particular customer needs
- Total distribution cost

Customer service and satisfaction:
- Customization level
- Customer query time
- Post transaction services

Logistics cost:
- Cost of assets and return on investment
- Information processing cost

3. 3D PRINTING TECHNOLOGY

Technology of 3D printing belongs to a class of techniques known as additive manufacturing. The key characteristic of additive processes is that they build objects layer-by-layer rather than through molding or subtractive techniques (e.g. machining and carving).(Murphy & Atala, 2014) At this point, 3D printers are able to produce objects from a variety of materials, such as plastic, metal, ceramics, glass, paper and even living cells. These materials can come in form of powders, liquids, filaments or sheets. There are now home 3D printers available, which cost less than $1000, but their possibilities are no match for industrial ones and have limitations.

A variety of 3D printing techniques are in use today, each having its own advantages and drawbacks. Most used additive manufacturing technologies are, according to (Manyika et al., 2013):
- **Selective laser sintering (SLS)**. In this technique, a layer of powder is deposited on the build platform, and then a laser forms a single layer of the object into the powder, fusing the powder together in the right shape. Afterwards the build platform moves down and more powder is deposited to draw the next layer. SLS does not require any supporting structure, which makes it capable of producing very complex parts. General Electric, for example, bought an SLS engineering company to build parts for its new short-haul commercial jet engine;
- **Direct metal laser sintering (DMLS)**. This technique is similar to selective laser sintering but deposits completely melted metal powder free of binder or fluxing agent, building as a result a part with all of the desirable properties of the original metal material. DMLS is used for rapid tooling development, medical implants and aerospace parts for high-heat applications;
- **Fused deposition modeling (FDM)**. A filament of plastic resin, wax, or another material is extruded through a heated nozzle in a process in which each layer of the part is traced on top of the previous layer. If a supporting structure is needed, the system uses the second nozzle to build that structure from a material that is later discarded (such as polyvinyl alcohol);
- **Stereolithography (SLA)**. A laser or other UV light source is aimed onto the surface of a pool of photopolymer (light-sensitive resin). The laser draws a single layer on the liquid surface; the build platform then moves down, and more fluid is released to draw the next layer;
- **Laminated Object Manufacturing (LOM)**. A sheet of material (paper, plastic, or metal) is fed over the building platform, adhered to the layer below by a heated roller, and a laser cuts the outline of the part in the current layer;
- **Inkjet-bioprinting**. Bioprinting uses a technique similar to that of inkjet printers, in which a precisely positioned nozzle deposits one tiny dot of ink at a time to form shapes. In cases of bioprinting, the material used is human cells rather than ink. The object is built by spraying a combination of scaffolding material (such as sugar-based hydrogel) and living cells grown from a patient's own tissues. After

printing, the tissue is placed in a chamber with the right temperature and oxygen conditions to facilitate cell growth. When the cells have combined, the scaffolding material is removed and the tissue is ready to be transplanted.

3D printing has several advantages over conventional construction methods. With 3D printing, an idea can go directly from a file on a designer's computer to a finished part product, potentially skipping many traditional manufacturing steps, including procurement of individual parts, creation of parts using molds, machining to carve parts from blocks of material, welding metal parts together, and assembly. 3D printing can also reduce the amount of material that is wasted during the process of manufacturing and create objects that are difficult or impossible to produce with traditional techniques, e.g. objects with complex internal structures that add strength, reduce weight, or increase functionality. In metal manufacturing, for example, 3D printing can create objects with an internal honeycomb structure, while bioprinting can create organs containing internal network of blood vessels.

3D printing is also gaining traction for direct production of tools, molds, and even final products. These newer uses of 3D printing could enable unprecedented levels of mass customization, shrinking and making supply chains less costly, and even the "democratization" of manufacturing as consumers and entrepreneurs begin to print their own products. Looking longer term, perhaps beyond 2025, one category of 3D printing – bioprinting of living organs – has long-term potential to save or extend many lives. (Lee & Stewart, 2014)

4. EFFECT OF 3D PRINTING ON THE SUPPLY CHAIN

As implications of the technology expand and prices drop, the first big implication is that more goods will be manufactured at or close to their point of purchase or consumption. As a result, many goods that have relied on the scale efficiencies of large, centralized plants will be produced locally. Even if the per-unit production cost is higher, it will be more than offset by the elimination of shipping and of buffer inventories. Parts could be made at dealerships and repair shops, and assembly plants could eliminate the need for supply chain management by making components as needed. (D'Aveni, 2013)

Another implication is that goods will be customized at an unprecedented level because altering them won't require retooling, only slight modifications of instructions in software. For some industries and some products, the concept of "on-demand" manufacturing could radically change business models and supply chains. Consider, for example, a homeowner needing a spare part for a dishwasher. He orders the part online from the manufacturer, receives a bar code for the part and gets it printed at a local 3D printing center, perhaps at a library, post office or a big box retailer. Such a scenario shrinks the supply chain to almost one link – eliminating those connecting development, prototyping, production, delivery, and warehousing of parts. A survey conducted by PricewaterhouseCoopers presents what are the most likely implications of 3D printing on modern businesses. The chart below shows the results.

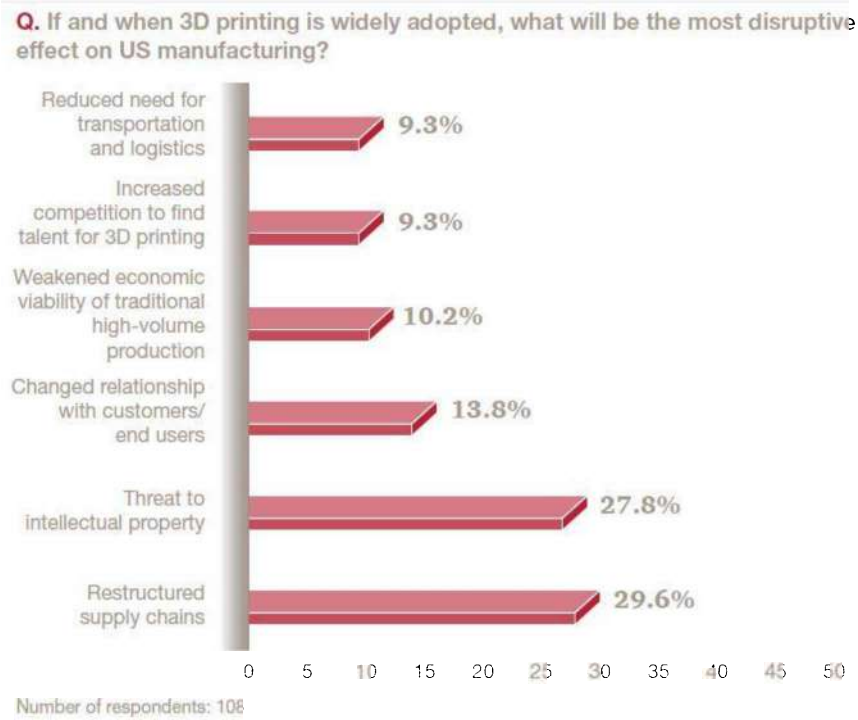


Figure 2: How could 3D printing disrupt? Supply chain restructuring and intellectual property threat tops the list (McCutcheon, Pethikc, Bono, & Thut, 2014)

Whether its impact is evolutionary or revolutionary, 3D printing technology is recognized as a striking trend that will significantly impact supply chains. Those that do nothing will be left wanting, because the influence of 3D printing technology on supply chains is expected to grow. (Sebastian & Omera, 2015)

Based on assessments stated, the 3D printing could cause a supply chain to look a lot simpler, as shown in the Figure 3.

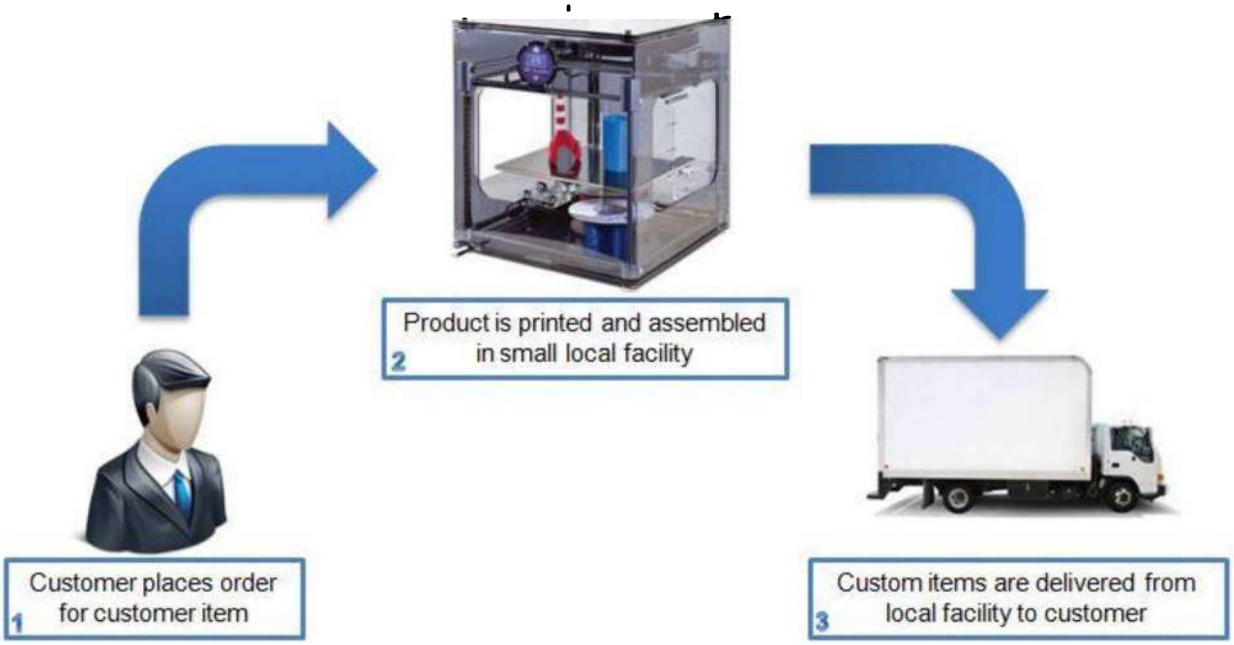


Figure 3: New supply chain model using 3D printing technology

A supply chain having these characteristics would show superior performance in almost all, or the vast majority of supply chain metrics, compared to traditional supply chain. The impact of supply chain on the business of the future is inevitable. The precise form and scope of it are still to be shown. The interest and hype it is creating is impressive. A fact that shows that it is not only a hype is that professional services firms, such as Deloitte, are offering courses in additive manufacturing (Nanney & Cotteleer, 2015). Process is fairly simple, starting with an Auto CAD file, which is afterwards loaded into the 3D printer, which assembles the object based on that. It is clear that new forms of employee training are required for that and already now can we see the steps made towards it, especially in the defense, automotive and aerospace industries, which possess the biggest traction for adopting this technology.

5. CURRENT DRAWBACKS OF 3D PRINTING AND ROOM FOR ADVANCEMENT

The technology of 3D printing has been developing since 1980s, but it still has drawbacks that need to be addressed in order for it to become truly widespread. There are now home printers available, at reasonable prices, even below $1000. But these do not provide perfect performance. Mostly used for prototyping, home printers are producing objects of low-strength capabilities. The 3D printers are about at the same stage as the PCs were in the initial stage of their development. (Lee & Stewart, 2014) Current limitations of 3D printing, which vary by printing technique, include relatively slow build speed, limited object size, limited object detail or resolution, high material cost and, in some cases, limited object strength. However, in recent years rapid progress has been made in reducing these limitations.

Additive manufacturing is still far away from producing massively final products. There will be some highly complex parts that are better made through 3D methods (such as certain aerospace components, like turbine blades), or unique situations where there is no room for a machine shop and the nearest parts depot is far away (such as the International Space Station). Special potential of 3D printing is for spare parts industry. Currently, 3D printing is mostly used by automotive industry (about 40% of all devices used), and medical with about 15%, where the biggest user are dental markets and audiology.(Lee & Stewart, 2014)

Drawbacks of 3D printing do not come down only to current technical limitations, which are likely to be significantly improved. There are some cons that are directly related to the nature of additive manufacturing. Namely, 3D printers may pose a health risk when used at home. The emissions from desktop 3D printers are

similar to burning a cigarette. While heating the plastic and printing small figures, the machines using PLA filament emitted 20 billion ultrafine particles per minute, and the ABS emitted up to 200 billion particles per minute. (Stephens, Azimi, El Orch, & Ramos, 2013) These particles can settle in the lungs or the bloodstream and pose health risk, especially for those with asthma.

Next, 3D printers consume a lot more of electrical energy than e.g. injection molding to make an item of the same weight. Because of this, 3D printers are better for small batch runs. Industrial-sized 3D printers may not be the answer to lessening our use of coal power any time soon. Furthermore, additive manufacturing vastly relies on plastic in its process. One of the biggest efforts recently have been efforts to reduce reliance on plastics, from grocery bags to water bottles to household appliances that can be made from recycled materials instead. Though using raw materials reduces the amount of waste in general, the machines still leave unused or excess plastic in the print beds. The plastic byproduct ends up in landfills, which overall produces additional environmental concern.

Overall, intellectual property is an issue that needs to be taken into consideration seriously in order to create a sustainable model for using 3D printers. 3D printing will change the business market, but also provide possibility for black market for these items. That means that the legislation will have to be created accordingly to catch up with the progress. This potential digital piracy is similar to the way the internet challenged the movie and music industries for copyright, trademarks and illegal downloads.

Finally, there is also a vast room for abuse of 3D printers, which could be used to make weapons, drugs and similar illegal and/or so far narrowly controlled items.

6. 3-D PRINTING IN PRODUCTION OF ORTHOPEDIC INSOLES

Orthopedic insoles are typical products that can be produced using traditional methods, but for which 3-D printing provides broad advantages. Here are highlighted some changes to the supply chain design if 3-D printing is used for producing orthopedic insoles.

The traditional supply chain of orthopedic insoles - Many consumers regularly purchase orthopedic insoles for health reasons to help deal with defects in the natural shape of the foot or positioning of the foot during standing or walking. The insoles are usually partly machined and partly handcrafted. The insole manufacturer holds inventories of cork, plastic and leather, which are the main components for the insole. Cork and plastics are used for the basis of the insole, while a leather top-layer is often assembled at the end of the production process. The cork and plastics cannot be used right away, but need pre-production before they can serve as input materials for the final assembly of the insole. Traditionally, purchase of an orthopedic insole requires frequent contact between the client and an orthopedist, and resultantly the insole manufacturer.

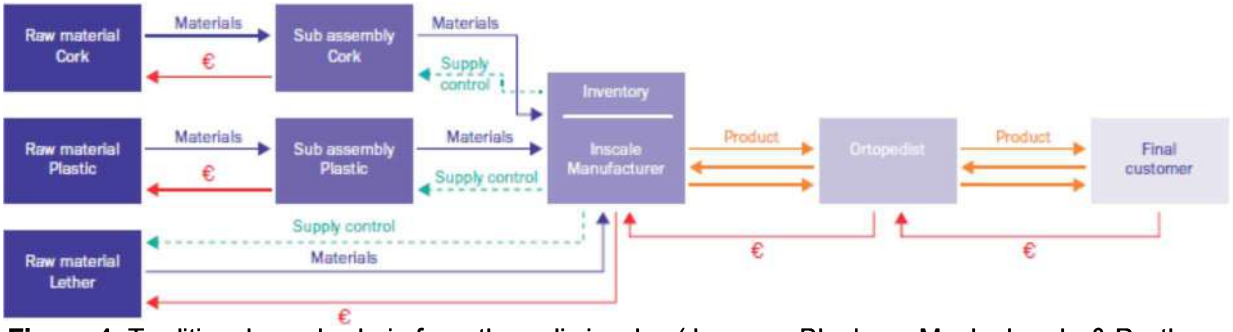


Figure 4: Traditional supply chain for orthopedic insoles (Janssen, Blankers, Moolenburgh, & Posthumus, 2014)

The orthopedist takes a foam print or plaster cast from the client's foot and determines which physical adjustment the client needs. Then he sends the scan, along with his notes, to the insole manufacturer. The insole manufacturer receives the customer's foam scan from the orthopedist, interprets the orthopedist's notes and it fabricates the sole using CNC manufacturing technology. After the sole is finished, it is sent to the orthopedist who will perform the final fitting with the customer. Most clients, however, are not satisfied with the product the first time around and usually adjustments to the insole are needed. The insole is send back and forth from manufacturer to orthopedist to optimize the fitting, and the customer has to visit the orthopedist every time for fitting. The total process easily takes up four to six weeks and costs of the final product are around €200.

The 3-D printed orthopedic insole supply chain – Three-dimensional printing technology offers significant advantages for biomedical devices due to its ability to manufacture low-volume or one-of-a-kind parts on-demand based on patient-specific needs, at no additional costs for various designs. (Bandyopadhyay, Bose, & Das, 2015) Orthopedic insoles can also be manufactured using 3-D printing technology. When insoles are fabricated by means of 3-D printing, the supply chain changes significantly as fewer types of materials are used and production quality increases. The orthopedist, again, takes a foam print from the client's foot, adds the required adjustments to the model. However, the orthopedist can also take a direct 3-D scan from the client's foot, digitally add the required adjustments and send the digital model to the 3-D printing manufacturer. The manufacturer produces the insole straight from the design. This time around, there's less room for human induced error. The strict integration between 3-D scan and 3-D print ensures that a single moment of contact between client and orthopedist should be enough for a correct fitting. The client can even decide to collect the insole at the production location, or to have the final product sent to his home address, omitting the fitting process at the orthopedist at all.

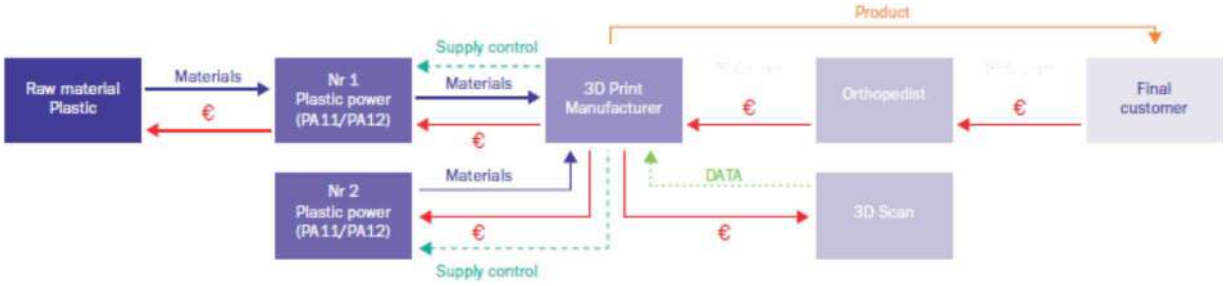


Figure 5: 3-D printed orthopedic insoles (Janssen et al., 2014)

There are several implications in terms of the impact of 3-D printing on supply chain management. For starters, the number of materials used in the insole is reduced. Instead of cork, a nylon powder (polyamides PA11 and/or PA12) is used. The polyamides have the advantages that the materials are widely available, reducing sourcing challenges and dependence on suppliers. At the same time, insoles can become thinner but stronger using these materials. Also, customization can move beyond the level of customization offered by traditional methods. For instance, color and finishing of the insole can be determined by client, as he or she might want bright colored insoles with his or her initials carved into the basis. When using 3-D printing, the cost for one pair of insoles can be competitive with traditional methods, or be even cheaper. And 3-D allows for a much shorter total lead-time, thanks to the "First Time Right" 3-D printing process. Also there is a potential for an innovative channel in which a client can make the 3-D scan herself, using an iPad and an app, using a process called photogrammetry. The insole is printed at a 3-D printing supplier of the company providing the service (one example is a start-up named Sols, webpage: www.sols.co) and directly shipped off to the client for approximately $ 100.

7. USAGE OF 3-D PRINTING IN SERBIA

There are only few players that engage into this industry, and they do not present direct competition to each other, because each of them manages different area in the field.
A small number of companies in Serbia found a sustainable business model in this field. Models that are used are the following:

1. Printing service - on demand printing
2. Design service - modeling and prepress
3. Protopyping service – design, prepress and printing
4. Distributor/vendor of 3D printer

"3D Impulse" Laboratory is a scientific research unit of the Faculty of Mechanical and Civil Engineering in Kraljevo founded in 2013, which contemplates the employment of digital technologies to develop new products. "3D Impulse" Laboratory collaborates with companies through small projects which help continuous development of new and improvement of existing products. The laboratory is a center that provides a common education, consulting and development services to companies that individually would not be able to afford the use of modern technical achievements. The Laboratory is the only center in region that engages with this kind of deployment. It owns modern and high-priced equipment which uses SLS technology for rapid prototyping, rapid tooling and rapid manufacturing. Aside from these, the Laboratory offers other services, such as digitalization of 3D objects, quality control, education, product development and product mentoring. The technology grants the usage of wide variety of materials: metal (margin steel, stainless steel, aluminum, titanium), plastic (polyamide-nylon 12), composites (polyamide filled with glass particles, polyamide filled with aluminum particles, polyamide filled with carbon particles). "3D Impulse"

collaborates both with companies and entrepreneurs, and has cooperated with many domestic firms, but with the ones in Great Britain and Italy, as well. Their customers are individuals and companies who are usually export-oriented and seek for new approach in product manufacturing, through the cost and time saving method. It is projected that 500 entrepreneurs a year upgrade their knowledge, reduce costs and stay competitive on the market, and 400 models and prototypes (for new and improved products) are to be produced. The results of the "Impuls" project in the first year are remarkable: 316 companies went through the assessment of creativity process, 100 companies gained the product analysis, 300 models and 120 prototypes were produced, 50 companies benefited from mentoring and 180 individuals went through training process. Further, the income in those companies raised by 58,7% and 105 new openings were made, which led to employment increase by 3,76%. In addition, production cycle for specific companies reduced by 40%. (http://www.3dimpuls.com/, 2016)

Voxellab is a company that is focused on 3D printing, 3D scanning, 3D modeling and software development. It is an example of prototyping service although it offers high precision models with high resolution with Polyjet technology which currently represents the highest quality and most accurate 3D printing technology in the world market. 3D models made with this technology are characterized by extremely high quality surface and solid mechanical properties suitable for product visualization, functional testing and end use. (http://voxellab.rs/, 2016)

3Dcaddit is a distributor of equipment and devices for 3D printing and covers wide variety of technologies and products. They often do on demand printing with the companies that have bought equipment from them, such as **3D svet**. Along with aforementioned active companies there are also many smaller companies and individuals that offer products and services made on amateur and semi-professional 3D printers. There are also numerous non-profit organizations, such as faculties and other educational organizations, that are equipped with some 3D technology devices, but they are often not available to the public.

Polyhedra is a registered “fab lab” (fabrication laboratory), a workshop equipped with 3D printers and other technologies for digital fabrication. They are trying to bring technology closer to entrepreneurs or any other individual who wants to make a product from an idea in an non-commercial way. While “fab labs” have yet to compete with mass production and its associated economies of scale in fabricating widely distributed products, they have already shown the potential to empower individuals to create smart devices for themselves. These devices can be tailored to local or personal needs in ways that are not practical or economical using mass production. (http://www.polyhedra.co/, 2016)

Along with other numerous projects, Polyhedra has started six projects regarding usage of 3D printing technology in biomedicine. Regarding the topic of the paper, only one of the projects will be elaborated and that is the one that considers usage in prosthetics. They are assembling an artificial hand, made of plastics for a specific individual who has lost his hand. The process of making such hand consists of several phases. First, they developed a static hand, followed with added mechanism with levers and strings. Then they integrated specific technology for controlling contractions of the muscle. Last phase will be completely mechanized system which allows a person to move the fingers of the prosthetics by himself. Needless to say that the price of such hand will be multiple times lower in comparison with artificial prosthetics made so far without 3D printer.

8. CONCLUSION

It is beyond any doubt that 3D printing is a technology that will have a massive impact on how many companies are dealing with their challenges globally. Additive manufacturing has been developing over the past couple of decades to that extent that the pioneers have already established themselves on the different markets. Not only specialized centers for providing different services of 3D printing, but also large corporations, such as car manufacturers, are proof that the potential of this technology has been recognized. Its impact is already considerable, but all implications are that it will have an even stronger influence, shifting its position from a potential industry changer to a regular tool of everyday business, especially after further developing its characteristics.

Benefits of the supply chain using the technology are numerous. Reduced transport and logistics costs, reduced inventory levels, less scrap materials, fewer stages of production and, consequently, fewer supplier and intermediaries in the process are just some of the reasons on the cost side that justify the usage of 3D printing. A massive argument for using it is also the possibility of endless customization at a minor cost.

Given the complexity of the products needed, it is no wonder that the medical industry has also become a significant user of additive manufacturing technology. Different apparatus needed are ideal candidates for

exploiting the potential of 3D printers. The fact that every patient is different puts additional value on 3D printing customization abilities. There are several research centers and companies in Serbia that are offering high-value products and services using additive manufacturing. There is no doubt that impact is going to be even bigger as the technology continues to evolve.

REFERENCES

Bandyopadhyay, A., Bose, S., & Das, S. (2015). 3D printing of biomaterials. *MRS Bulletin*, *40*(2), 108–114. http://doi.org/10.1557/mrs.2015.3

Company website http://www.3dimpuls.com/, Date of access: 02.04.2016.

Company website http://polyhedra.co/, Date of access: 02.04.2016.

Company website http://voxellab.rs/, Date of access: 02.04.2016.

D'Aveni, R. (2013). 3-D Printing will change the world. *Harvard Business Review*, (March), 36.

Gunasekaran, A. (2004). A framework for supply chain performance measurement. *International Journal of Production Economics*, *87*(3), 333–347. http://doi.org/10.1016/j.ijpe.2003.08.003

Janssen, R., Blankers, I., Moolenburgh, E., & Posthumus, B. (2014). TNO: The impact of 3-D printing on supply chain management, (April).

Lee, P., & Stewart, D. (2014). 3D printing is a revolution: just not the revolution you think. Retrieved from http://www2.deloitte.com/global/en/pages/technology-media-and-telecommunications/articles/tmt-pred-3d-printing-is-revolution.html

Manyika, J., Chui, M., Bughin, J., Dobbs, R., Bisson, P., & Marrs. (2013). Disruptive technologies: Advances that will transform life, business, and the global economy. *McKinsey Global Insitute*, (May), 163. Retrieved from http://www.mckinsey.com/insights/business_technology/disruptive_technologies\nhttp://www.chrysalixevc.com/pdfs/mckinsey_may2013.pdf

McCutcheon, R., Pethikc, R., Bono, B., & Thut, M. (2014). 3D printing and the new shape of industrial manufacturing, (June), 8. Retrieved from http://www.pwc.com/us/en/industrial-products/assets/3d-printing-next_manufacturing-chart-pack-pwc.pdf

Mentzer, J. T., Dewitt, W., Keebler, J. S., Min, S., Nix, N. W., Smith, C. D., & Zacharia, Z. G. (2001). Defining supply chain management. *Journal of Business Logistics*, *22*(2), 1–25. http://doi.org/10.1002/j.2158-1592.2001.tb00001.x

Murphy, S. V, & Atala, A. (2014). 3D printing. *Nature Biotechnology*, *32*(8), 773–785. http://doi.org/10.1038/nbt.2958

Nanney, R., & Cotteleer, M. (2015). 3D Printing Is Transforming the Supply Chain. *CIO Insight*, 1. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=101351139&lang=pt-br&site=ehost-live

Sebastian, M., & Omera, K. (2015). 3D Printing and Its Disruptive Impacts on Supply Chains of the Future. *Technology Innovation Management Review*, *5*(11), 20–24. Retrieved from http://timreview.ca/article/942

Stephens, B., Azimi, P., El Orch, Z., & Ramos, T. (2013). Ultrafine particle emissions from desktop 3D printers. *Atmospheric Environment*, *79*, 334–339. http://doi.org/10.1016/j.atmosenv.2013.06.050

Vrijhoef, R., & Koskela, L. (2000). The four roles of supply chain management in construction. *European Journal of Purchasing & Supply Management*, *6*(3-4), 169–178. http://doi.org/10.1016/S0969-7012(00)00013-7

SUPPORTING DEVELOPMENT OF TECHNOLOGICAL STARTUPS THROUGH MENTORING

Milan Okanović[1], Jelena Anđelković Labrović[1]*, Tijana Stefanović[2]
[1]Faculty of Organizational Sciences, University of Belgrade
[2]Student of Faculty of Organizational Sciences, University of Belgrade
*Corresponding author, e-mail: jeca@fon.bg.ac.rs

Abstract: *In the last few years, the field of technological entrepreneurship has been the main subject of interest for many researchers who have showed the awareness of the significance of the development of entrepreneurship and small and medium enterprises (SMEs), for job creation, new possible workplaces, as well as creating a better environment for a society. Technological startups are mostly being created in environment in which there are preconditions for their successful development. One of the preconditions of its development is organizations and individuals who through different forms of mentoring programs and education increase the chance for startups to become profitable companies. In this paper, with overview of contemporary literature within this field of technological startups mentoring as a means of support is analyzed during the process of development of technological startups. Also, key benefits of mentoring as a form of education during the development of technological startups will be explained.*

Keywords*: technological entrepreneurship, technological startups, mentoring*

1. INTRODUCTION

According to Petti and Zhang (2011), technology could be used for creating values only in the case when being implemented in new products, when those products find their market and when they are able to generate additional profit to companies, profit for the investors, acknowledgment for developers and benefits for society. These authors see scientific accomplishments, inventions and technological development as a base ground for creating values and competitiveness, but they emphasize that finding new technological market opportunities and their commercial exploitations as main reasons for creating competitive advantage on the market. According to these authors, technological entrepreneurship represents transformation of technology into value.

According to Petti (2009) technological entrepreneurship contains three main components:

1. entrepreneurial component – a set of activities which are implemented by individuals and companies in order to identify and use specific potential of new technologies and market opportunities,
2. management component – a set of activities done by individuals and companies in order to develop appropriate value offers which enables fast market entry, with business model which has been tested and with which identified market opportunities are being used,
3. environment component – a number of formal and informal organizations for support and resources which enable adequate conditions for development of technological new ventures (state policy, law and regulations, industrial standards, public and private organizations which support entrepreneurship development, culture, community and inter organizational connection).

In this paper the concept of environment of technological startup in a form of support during the development of technological startups will be further elaborated.

1.1. Technological startup

At the beginning of every new venture there is initial stage which is called startup stage (Crowne, 2002), and main characteristics are high dynamics and orientation towards the future. Taking into consideration new venture at this stage of development, as well as the fact that simplified terms are being used now days, “startup” and “new ventures” are going to be referred to as synonyms.

Blank and Dorf (2012) define “startup” as a temporary organization created in order to discover a sustainable business model with a high potential for growth. Duening (2015) had additionally explained Blank’s startup definition, stating that “repeatable” actually means that organization seeks for model which will consistently create and deliver value to customers, where “scalable: means ability of a business model to be created in accordance to customer base growth.

Kariv (2013) explains the term of technological startup as a specific form of entrepreneurship. According to this author, technological startups are new ventures in an early operating stage, which are created in the fields of innovations and newest technologies, and are characterized by high dynamics, orientation for growth, profit and creating new market values. Technological startups are usually created in environment in which there are preconditions for their successful development.

2. ENVIRONMENT FOR DEVELOPMENT OF TECHNOLOGICAL STARTUP

A number of connected institutions which have a common goal to support entrepreneurs throughout all stages of development of new ventures are called entrepreneurial ecosystem (Isenberg 2010). According to this author, entrepreneurial ecosystem can be defined as a network of services with entrepreneur in focus, towards which all of the activities are aimed at and who represents the measure of success of its existence. Mason and Brown (2014) define entrepreneurial ecosystem as number of mutually connected members (existing or potential), entrepreneurial organizations (for example: investment funds, angel investors and others), institutions (universities, public agencies, and financial organizations) and various entrepreneurial processes, which are formally or informally connected, mediating and managing performances of local entrepreneurial environment. Feld (2013) calls entrepreneurial ecosystem – "entrepreneurial community." According to this author, aside from ineffective clusters created by government institutions, entrepreneurial community is formed via informal way and with "bottom – up" approach. Also, entrepreneurial community is led by entrepreneurs, and its creation is based upon mutual networking among individuals and informal activities of entrepreneurs.

Neck with associates (2004) defines basic components of entrepreneurial ecosystem. These include formal and informal networks among entrepreneurs, universities, state and local government, professional consultants, owners of investment capital and talented candidates. Conceptual framework of entrepreneurial ecosystem was defined by Suresh and Ramraj (2012), which represents eight factors of support for entrepreneurs. According to these authors, the support for an entrepreneur can be: moral, financial, technological, market support, social, networking support, government support, as well as environmental support.

Components of startup ecosystem have individuals in center, who based upon their own ideas and inventions create their own innovative startups. Their environment consists of: support component (incubators, mentors, and companies for specialized services), market component (initial buyers/users and big companies), human resources component (individuals with knowledge and skill, and educational institutions), financial component (financial capital, angel investors, accelerators, investment funds, and others), cultural component (events, social norms and experiences), and political component (local and state government). One more term is very specific for this ecosystem, and it is common in new startup scene, and that is "startup community", which Feld (2012) explains in his work.

In this paper, mentoring as a very important support component, as well as the role of mentoring in different forms of support for technological startups will be elaborated.

3. SUPPORT IN DEVELOPMENT OF TECHNOLOGICAL STARTUPS

In the process of development of technological startups, different stakeholders can be identified. Type of stakeholders , depend on in which stage startup is in, and they can influence or be influenced by during the process of its development (Freeman, 2010).

Birdsall (2013) emphasizes as important in the process of development of technological startups the following stakeholders: the founders, angel investors, investment funds, corporate partners, mentors, business incubators, and alumni. Suresh and Ramaj (2012) give a conceptual framework of entrepreneurial ecosystem which they represented through eight types of support for entrepreneurs (table 1).

Table1.Types of support for entrepreneurs (Suresh &Ramaj, 2012)

Type of support	Participants and support form
Moral support	Family, relatives, spouses, friends and community.
Financial support	Closest family, banks, investment funds, friends, relatives, educational institutions, individual investors – business angels, accelerators, small market capital investors, foreign financial institutions, government bodies, and suppliers - creditors,
Technological support	Business incubators and accelerators, technical and technological educational institutions, talented candidates

Market support	Market opportunities, government reports and economy associations, fairs, and others,
Social support	Professional associations prizes, media, social acknowledgment as well and acceptance of entrepreneurial failure,
Networking support	National association of entrepreneurs, alumni associations, social networking websites, supplier and vendor networks,
Government support	Entrepreneur clusters, state educational centers, state incentive and rewards institutions, regulatory state institutions
Environmental support	Availability of natural resources and climate conditions

Startups usually find support for development of ideas within organizations/individuals that support development of entrepreneurship: business incubators, business accelerators, and business angels. Due to their significance for the success of technological startups, these three types of support will be further elaborated in more detail from the perspective of mentoring. Mentors within these types of support for technological startups can be successful entrepreneurs, people who have gone through mentorship programs themselves, big investors, business angels, or experts from various companies.

4. THE ROLE OF MENTORING AS A SUPPORT FOR DEVELOPMENT OF TECHNOLOGICAL STARTUPS

4.1. Mentoring

Garvey et al. (2009) described mentoring as a relationship where more mature and experienced person is engaging in a relationship with a younger and less experienced person in order to assist learner to integrate as a fully functioning person within the society they integrate, which is called the core mentoring model. Now days, a mentor could be a peer also, with the main purpose of the relationship which is transferring knowledge and skills. Beevers and Rea (2010) emphasized that *mentoring is about two people coming together with a view to helping one of them progress more easily through work, life or whatever context the mentoring is taking place in.* Also, mentoring is seen as a long standing form of training, learning and development and an increasingly popular tool for supporting personal development (CIPD,2009).

Beevers and Rea (2010) identify different models of mentoring: 1. group mentoring, 2. group peer mentoring, 3. online mentoring, 4. one-to-one mentoring, 5. one-to-one peer mentoring and 6. line manager mentoring. The most used model within technological startups is group mentoring and one-to-one mentoring.

Mentoring activity could be found in all sectors of society. Mentoring could be voluntary or paid activity but in most cases mentoring is associated with voluntarism (Garvey et al, 2009). As it is showed in CIPD Annual Survey Report about Learning and Development (2015) mentoring and budding schemes are in the top 3 most used talent management activities, and that ¾ of organizations use some kind of coaching or mentoring activities which is increasing every year. Therefore it is important to emphasize that there are various purposes of mentoring and that they could be (Beevers and Rea,2010) to provide role models so that mentees could look up to them, provision of a sounding board (a person with whom a mentee is going to able to discuss ideas, concerns or problems), provision of a advice from some who had had experience and who has been in similar situations, enablement of work-related development, provision of an advocate who could help support, represent and champion mentee when that is needed. Also a mentee could use the provision of contacts and access to opportunities, as well as having someone who will prepare a mentee to be adept while managing relationship and achieving their goals.

The authors state that in reality there is a very small chance that a mentoring relationship is restricted to just one of these activities, but that real benefit of mentoring is that mentors and mentees will work together in different ways to suit their concrete needs at any time.

To the question of who can benefit most from mentoring relationship, answer is presented by Noe (2010) who claims that both mentors and mentees can benefit. Mentees benefits are presented as career and psychosocial support provided by mentors. In most of the cases career support is seen through coaching, protection, sponsorship, providing challenging assignments, exposure, and visibility and psychosocial support includes serving as a friend and a role model, providing positive consideration and acceptance, and providing an means for the mentee to talk about anxieties and fears. Mentoring relationships provide opportunities for mentors as well such as to develop their interpersonal skills and increase their feelings of self-esteem and worth to the organization and society.
Additional benefits for mentees are connected to the learning activities as a result of a mentorship process which can result with gaining knowledge and developing skills. If we look at these learning activities it could

be stated that most of the learning is happening trough role modeling and observation as elements of social learning theory, meaning that in a mentoring context, mentees learn by observing the mentor (Jones, 2013) In order to implement successful mentorship programs first important issue is that mentors should be chosen based on interpersonal and technical skills, and second is that they need to be trained (Noe, 2010,page 373).

Looking at the specifics within mentoring entrepreneurs it could be stated that there is lot of benefits as well as power in it. This is the process in which successful entrepreneurs and business people act as mentors and advisors for entrepreneurship. As a good and helpful mentorship programs are considered programs in which the mentors provide guidance and support to entrepreneurs. Mentoring in an entrepreneurial context may encompass direct forms of help, more parallel to advising or even consulting, which could be argued as a broader than mentoring in other environments (Gimmon,2014).

Rigg and O'Dwyer (2012) have found that mentors could be recognized as significant for developing entrepreneurs and those could be understood as a source of knowledge transfer or as individuals who help aspiring entrepreneurs to reflect and construct knowledge. The mentoring network for a technological startup program could be viewed as a community of practice that provides orientation for entrepreneurs in order to stimulate their learning of how to survive, their acquisition of status and identity, not only their development of practical skills. The mentoring network is also open access to the social capital that is of such importance to the success of a new venture, being admitted into a community of entrepreneurs who recognize and acknowledge each other for their risk taking, nous, wits, achievements and bruises (Rigg and O'Dwyer, 2012).

4.2.Role of mentoring within different types of technological startups support

Organizations and individuals who support the development of technological startups have a significant role in entrepreneurial ecosystem offering services and help in development of their business, help with defining and creating initial products, identifying attractive market segments, providing capital and human resources – mentors and others. Further in the paper the following types of support will be explained in more detail: business incubators, business accelerators, and business angels, within which mentoring representationwill be observed.

Business incubators are organizations which support entrepreneurial ventures in process of development offering help with development of their business (Grimaldi & Grandi 2005). Fominiene (2010) defines process of business incubation as "business incubation is the innovative, heterogeneous (multiple) and able to transform the business development of SMB's process, during which the support is provided for newly formed and start-up SMB companies thus contributing towards establishment of new, independent and successfully operating in the market companies". Incubators contribute to the process of strengthening new companies before they become independent (Cohen 2013).

Cohen (2013) defines business accelerators as organizations which contribute new ventures with defining and building initial products, identifying attractive market segments, providing capital and human resources. They establish this through time-limited support program, and they usually last around three months. Program include initial investment, working space, networking, education and training by mentors who can be successful entrepreneurs, the ones who have been through the mentorship program, big investors, business angels or experts from various companies. The program usually ends with a demonstration day, where new ventures are presented to bigger audience or investors.

Business accelerators help build a good team of new venture, defining ideas and mentoring the development of a venture from idea, through prototype, and finally to the final product development (Hoffman & Radojevich-Kelley, 2012). These authors emphasize that mentorship program within business accelerators contribute to higher success because they provide contact with individual and big investors and conclude the following:

- Team motivation in business accelerators differentiate from team motivation within teams who develop themselves with different type of support.
- Ventures that have finished program within the accelerator have higher rate of success (the duration of business and investments) in comparison to those who have not.
- Accelerator use different criteria when selecting new ventures and analyzing ideas, in comparison to groups of programs for supporting development of ideas.
- Founders of accelerators and new ventures face the same obstacles and challenges.
- The additional value of accelerating program is that it provides mentoring and networking.

Huijgevoort (2012) in his research stated that number and quality of mentors engaged in development of new ventures also affects the value creation in accelerator. Quality of mentors is reflected in his expertise and previous entrepreneurial experience, which significantly contributes to value creation during the program, but in connection to other relevant stakeholders which mentor has. Also, this author states that it is important that each startup gets assigned with adequate mentor.

Miller and Bound (2011) also claim that accelerators have higher impact on success of new ventures in comparison to incubators because of implemented mentorship program amongst other things. Mentorship program consists of creating environment that will contribute to better development of a startup. That includes participation in lectures held by experts, after which individual meetings with the teams are being organized. The overall goal of these meetings is giving feedback about the new venture, but also creating a long-term relationship with mentors and experts which later on could be potential investors. On the other hand, accelerators organize different types of events, for example: legal aspect of entrepreneurship, tax policy, presentation skills, etc.

Another important stakeholder group is individual investors or "business angels". Either as individuals or as a group they give the initial seed to companies in making, and to their new ventures, but at the same time they give business advice (Cohen, 20130). A high number of those oriented to technological entrepreneurship have tendency to invest their own funds in new ventures with high risks, from whom a huge return on investment is expected (Aram, 1989). Freear (1994) states that they are part of informal capital market, and usually they are not that accessible to entrepreneurs. The same author describes them as people who are well educated, middle aged with a significant business experience and have had significant effect on the market.Business angles who have invested in startups mentor only when in need without defined development program as oppose to accelerators. Therefore their role is considered limited.

In her paper Cohen (2013) makes a difference between accelerators, incubators and business angels based on: the duration of development of new venture, characteristics of internal community, characteristics of a business model, the selection process and mentoring program, education and networking with other stakeholders. The similarities and differences between incubators, accelerators and business angels are represented in table 2.

Table2.The similarities and differences between incubators, accelerators and business angels(Cohen, 2013)

	Accelerators	**Incubators**	**Business angels**
Process length	3 months	1-5 years	Permanent
The joint team work	Yes	No	No
Business model	Investment	Rent	Investment
Selection process	Competitive, cyclic	No competition	Competitive, permanent
Stages of development	Early	Early or late	Early
Education	Seminars	Add hoc	None
Location	Usually at location	At location	Without permanent location
Mentoring	Intense	Minimal	Optionally

We can conclude that mentoring and education are mainly used within business accelerators, so in the following chapters a role and significance of mentoring in these organizations will be furthermore explained.

4.3. Mentoring in business accelerators

In his thesis Barrehag (2012) highlights three important components of stakeholder's network within accelerators: startup, mentors, and investors. Each one of the stakeholders has their own specific participation and benefits from realization of accelerator program. The impact model of these three stakeholders is represented in figure 1. Similar to this author, Birdsall (2013) states that the most important participants within the accelerators' programs of development are: founders of new venture, business angels, investment funds, corporate partners, mentors, incubators and alumni.

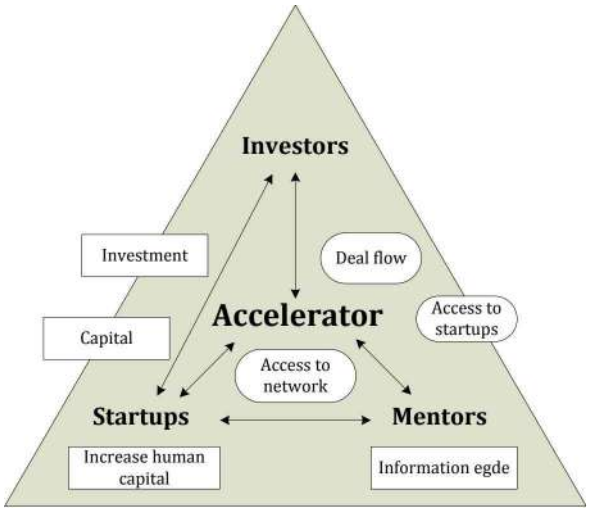


Figure 1.The conceptual model of the network of stakeholders in the business accelerators (Barrehag, 2012)

According to this same author, with a relationship with mentors, a startup has more chance to become profitable company. In this respect, education is highlighted as a key activity for many entrepreneurs which is not provided outside of participation in the accelerator. Based on the research that Birdsall (2013) conducted, the most important benefit for entrepreneurs is reputation their new venture gains after realization of a program within accelerator. When choosing accelerator program, entrepreneurs find as most important factors: quality of mentors, brand and reputation of the program and possibility for networking.

Stakeholders who contribute the most to increasing the value of new ventures are mentors, who are engaged in the program of an accelerator and who through the mentoring develop human resources of new venture (Huijgevoort, 2012). Also, mentors are one of the key factors of attractiveness of an accelerator. However, reason and motivation behind mentors' participation does not always have to be financial benefit, through part time or full time engagement, but it can also be of altruistic nature. Mentors are often very ambitiously oriented towards creating entrepreneurial community in their environment, and with participation in program within accelerators mentors remain in touch with the latest entrepreneurial ventures that develop.

5. CONCLUSION

In order to adequately explain the essence of this paper the role of mentoring in the development of technology startups is elaborated. Within the paper, technological entrepreneurship was firstly discussed and then the environment and its significant impact on the development of technological startups. The environment can provide various forms of support. In this paper support from the organization is emphasized (business incubators and accelerators) as well as support from individuals (business angels) as important elements within developed entrepreneurial ecosystem. Considering these forms of support, the role of mentoring is particularly analyzed and it was found that training and mentoring is mostly present in the business accelerators. It is shown that the key benefits from mentoring for mentees are career and psychosocial support. As Rigg and O'Dwyer (2012) have stated, mentoring in an entrepreneurial context includes direct forms of help, more parallel to advising or even consulting, which are explained as a broader than mentoring in other environments. Mentoring should provide orientation for entrepreneurs in order to stimulate their learning from how to survive their acquisition of status and identity, to as well as their development of practical skills.

Challenges for further research based on the analysis in this paper could be imposed through following question: Did the mentors have any training for the mentoring role, in other words are they lacking mentoring skills? Also, it is necessary to investigate the structure and performance of the mentoring programs, especially taking into account that during the incubation period a change of mentors happens often because most of them are not able to continuously work on the development of startups over a long period of time. Special direction for future research is proposed as structuring of performance indicators of mentoring engagement and mentoring programs in order to enable evaluation of the their contribution in technological startups development.

REFERENCES

Aram, J. D. (1989). Attitudes and behaviors of informal investors toward early-stage investments, technology-based ventures, and coinvestors. Journal of Business Venturing, 4(5), 333-347.

Barrehag, L., Fornell, A., Larsson, G., Mardstrom, V., Westergard, W., & Wrackefeldt, S. (2012). Accelerating success: A study of seed accelerators and their defining characteristics. Gothenburg, Sweden.

Beevers, K., & Rea, A.D. (2010). Learning and Development Practice. CIPD

Birdsall M., Jones C., Lee C., Somerset C., Takaki S. (2013) Business Accelerators: The Evolution of a Rapidly Growing Industry. Retrieved form: http://startup-accelerator.com/sites/default/files/cambridge_startup_%20accelerator_research.pdf.

Blank, S. G., & Dorf, B. (2012). The startup owner's manual: The step-by-step guide for building a great company. K&S Ranch, Incorporated.

Blank, S. G., & Dorf, B. (2012). The startup owner's manual: The step-by-step guide for building a great company. K&S Ranch, Incorporated.

CIPD (2009). Mentoring - CIPD Factsheet. Retrieved from https://www.shef.ac.uk/polopoly_fs/1.110468!/file/cipd_mentoring_factsheet.pdf

CIPD (2015). Annual Survey Report Learning and Development. Retrieved from https://www.cipd.co.uk/binaries/learning-development_2015.pdf

Cohen, S. (2013). What Do Accelerators Do? Insights from Incubators and Angels. Innovations, 8(3-4), 19-25.

Crowne, M. (2002). Why software product startups fail and what to do about it. Evolution of software product development in startup companies. In Engineering Management Conference, 2002. IEMC'02. 2002 IEEE International (Vol. 1, pp. 338-343). IEEE.

Duening, T. N., Hisrich, R. A., & Lechter, M. A. (2015). Technology Entrepreneurship: Taking Innovation to the Marketplace. Academic Press.

Feld, B. (2012). Startup communities: Building an entrepreneurial ecosystem in your city. John Wiley & Sons.

Fominienė, A. (2010). Transformation of business incubators: analysis and evaluation. (Summary of Doctoral Dissertation). Retrieved from http://vddb.library.lt/fedora/get/LT-eLABa-0001:E.02~2010~D_20101001_150930-48664/DS.005.1.01.ETD

Freear, J., Sohl, J. E., & Wetzel, W. E. (1994). Angels and non-angels: Are there differences?. Journal of Business Venturing, 9(2), 109-123.

Freeman, R. E. (2010). Strategic management: A stakeholder approach. Cambridge University Press.

Garvey, B., Stokes, P. & Megginson, D. (2009). Coaching and Mentoring (1nd ed.). SAGE Publications

Gimmon, E. (2014), Mentoring as a practical training in higher education of entrepreneurship, Education + Training, 56(8/9), 814 – 825, http://dx.doi.org/10.1108/ET-02-2014-0006

Grimaldi, R., & Grandi, A. (2005). Business incubators and new venture creation: an assessment of incubating models. Technovation, 25(2), 111-121.

Isenberg, D. (2011). The entrepreneurship ecosystem strategy as a new paradigm for economic policy: Principles for cultivating entrepreneurship. Presentation at the Institute of International and European Affairs.

Jones, J. (2013). Factors influencing mentees' and mentors' learning throughout formal mentoring relationships. Human Resource Development International, 16(4), 390-408.

Kariv, D. (2013). Start-Up and Small Business Life. Encyclopedia of Creativity, Invention, Innovation and Entrepreneurship, 1734-1742.

Mason, C., & Brown, R. (2014). Entrepreneurial ecosystems and growth oriented entrepreneurship. Final Report to OECD, Paris.

Miller, P., Bound, K. (2011) The Startup Factories: The rise of accelerator programmes to support new technology ventures. London: NESTA (SF/72)

Neck, H. M., Meyer, G. D., Cohen, B., & Corbett, A. C. (2004). An entrepreneurial system view of new venture creation. Journal of Small Business Management, 42(2), 190-208.

Neck, H. M., Meyer, G. D., Cohen, B., & Corbett, A. C. (2004). An entrepreneurial system view of new venture creation. Journal of Small Business Management, 42(2), 190-208.

Noe, R. (2010). Employee training and development (5th ed.). McGraw-Hill

Petti, C. (2009). Cases in technological entrepreneurship: Converting ideas into value. Edward Elgar Publishing.

Petti, C., & Zhang, S. (2011). Factors influencing technological entrepreneurship capabilities: Towards an integrated research framework for Chinese enterprises. Journal of Technology Management in China, 6(1), 7-25.

Radojevich-Kelley, N., & Hoffman, D. L. (2012). Analysis of accelerator companies: An exploratory case study of their programs, processes, and early results. Small Business Institute® Journal, 8(2), 54-70.

Rigg, C. & O' Dwyer, B. (2012), Becoming an entrepreneur: researching the role of mentors in identity construction, Education + Training, 54 (4), 319 – 329, Retrieved from: http://dx.doi.org/10.1108/00400911211236181

Suresh, J., & Ramraj, R. (2012). Entrepreneurial ecosystem: case study on the influence of environmental factors on entrepreneurial success. European Journal of Business and Management, 4(16), 95-101.

van Huijgevoort, T. (2012). The 'Business Accelerator': Just a Different Name for a Business Incubator. Bachelor Thesis, Utrecht School of Economics, Utrecht, The Netherlands.

EVALUATION AND SELECTION OF TECHNOLOGY STRATEGIES USING QUANTITATIVE STRATEGIC PLANNING MATRIX

Milica Jevtić*[1], Ranko Demirović[2], Sanja Marinković[2]
[1] University of Belgrade, Faculty of Organizational Sciences & Comtrade Group
[2] University of Belgrade, Faculty of Organizational Sciences
*Corresponding author, e-mail: milica.jevtic@comtrade.com

Abstract: *In this paper we present the application of the Quantitative Strategic Planning Matrix (QSPM) in order to effectively prioritize strategic goals and business strategies. Evaluation and selection of the technology strategies using the QSPM analytical tool was conducted in Comtrade Group, a multinational corporation committed to excellence in all its operations. The management, actively involved into optimizing and improving its operations and processes, seeks to push the limits, gain competitive advantage and set industry standards in engineering and information technology. The QSPM analysis was therefore performed, to raise the quality, efficiency and strategic planning capacities and meet the ever growing expectations of prime quality. By conducting an external and internal analysis, SWOT, TOWS and QSPM, the company succeeded into determining and prioritizing strategies, derived from the carefully selected metrics, industry and data insights. It was found that by focusing on its core competences and taking advantage of the extensive knowledge of its employees and company's experience in a wide array of industries, the organization will be able to thrive, strengthen its position as regional leader in IT and successfully expand into new markets.*

Keywords*: Comtrade Group, technology strategy, Quantitative Strategic Planning Matrix (QSPM), SWOT, TOWS, technology evaluation and selection*

1. INTRODUCTION

A company's success in the market and its ability to be driven by innovation largely depend on strategies that are carefully designed and developed (Schilling, 2013). Technology and strategy represent two very complex schools of thought and the interface between the two areas becomes a concern when technology significantly affects performance (Burgelman & Wheelwright, 2004). Technology strategy is one of the functional strategies of a corporation. Formulating a technology strategy will enable a company to assess its current position and determine its future orientation by taking advantage and focusing on its core competences (Schilling, 2013). It defines activities concerning generating, assessment and selection of technology. In formulating and implementing the technology strategy managers have to pay attention to different internal and external factors. Technology strategy includes the objectives, strategies and tactics related to development and application of technologies within an organization. (Floyd, & Wolf, 2010)

Evaluation and selection of a technology strategy is not infrequently a complex undertaking, involving significant uncertainty, risk and need for a strategic mindset (Tan et al., 2011). There is a variety of methods which can be used to evaluate and select a strategy, including economic and mathematical models, peer review, interactive methodologies, optimization of portfolio and machine learning and artificial intelligence systems (Tan et al., 2011; Henriksen & Traynor,1999). Nonetheless, many of the mentioned methods are too complex or require considerable time to be implemented Choosing the most optimal methodology is critical not only to be able to quickly respond to the fast changing environment but to also create flexibility and set future orientation for the company (Schilling. 2013).

Large organizations as well as smaller firms need to assess their position in the market, strive to gain competitive advantage and reach their strategic goals by focusing on their core competences and values. Not infrequently, it is easy to loose direction and risk pursuing ineffective and inefficient business strategies, failing to maximize profits and augment company's value. In order to effectively prioritize the different business goals and strategies an organization should use in order to achieve its mission, the Quantitative Strategic Planning Matrix (QSPM) can become an effective analytical tool to clearly set priorities and identify the most critical objectives that need to be addressed first (David et al., 2009; David, 1986; Nasab & Milani, 2012). In particular, businesses in the most diverse industries can thrive when using the QSPM for the

purposes of strategic planning and management. Evaluation and selection of the technology strategies has been used in the case of Comtrade Group, a multinational corporation committed to excellence in all its operations. Each year, the company sets standards higher and higher, in particular when it comes to the speed, quality and uniqueness of its products and services. The management is actively involved into optimizing and improving its operations and processes. It seeks to push the limits, gain competitive advantage and set industry standards in engineering and information technology. As a result, the QSPM analysis was performed, to raise the quality, efficiency and strategic planning capacities and meet the ever growing expectations of prime quality. By first conducting an external and internal analysis (PESTLE, Porter's five forces, stakeholder analysis, BCG matrix), SWOT, TOWS and QSPM, the company succeeded into determining and prioritizing a variety of strategies, derived from the carefully selected metrics, industry and data insights. It was found that the company should focus on “bring new technology into the market by using excellent employee knowledge and expertise in a variety of industries”. By focusing on its core competences and taking advantage of the extensive knowledge of its employees and company's experience in a wide array of industries, the company will be able to thrive, strengthen its position as regional leader in IT and successfully expand into new markets.

2. COMPANY OVERVIEW

Comtrade Group, leading information technology organization in Southeast Europe, was founded in 1990 and is specialized in "the fields of software solutions, system integration, and hardware distribution" (Comtrade, 2015). Comprised of twenty-two companies that operate in eleven countries across Europe and North America, Comtrade has a well-established reputation as a reliable partner to both small and large enterprises. Innovative information technology solutions and services have contributed to a comprehensive and diverse portfolio with more than nine hundred satisfied clients in the public sector, government agencies, healthcare, telecommunications, automotive, finance, travel, logistics, gaming, and hospitality industries. The company is considered "pioneer in the area of near shoring and external R&D services and is a trusted developer of end-to-end technology product solutions in various industries" (Comtrade, 2015). Comtrade has several business concentrations: software solutions engineering, system integration, distribution and media. The solutions engineering is oriented toward clients worldwide and provides software and IT solutions, while the system integration works closely with Governments, their agencies, ministries, as well as with local enterprises and private companies. The media comprises of operations oriented toward the digital, Internet based content and channels, while the distribution business involves significant and major partners locally and worldwide (more than fifty IT and consumer electronics vendors), and it effectively covers the entire process: from import to distribution, in addition to logistics, service and support, focusing on efficient stock optimization and improvement of inventory rates. Comtrade an invaluable and large customer base for its distribution business: Retail, Telco, System Integrators, Value added and Internet-based re-sellers, as well as PC assemblers. Main product categories include consumer electronics, mobile phones, and information technology. The organization's vision is to become world leader in delivering high value end-to-end technology solutions, products and services while reducing business complexity with technology solutions for storage, enterprise application management and gaming technology. As Comtrade strives to achieve its mission, it is focusing on creating a culture of innovation that is focused on valuing knowledge, professionalism, passion for high quality work, accountability, entrepreneurship and reciprocal trust and respect.

3. METHODOLOGY

Starting from the organization's vision, mission and strategic goals, the external and internal analyses were performed. Trough careful review of historical data, documentation, interviews, and personal experience, the SWOT, TOWS and QSPM analyses were completed. In the external analysis particular focus was on the PESTLE and Porter's Five Forces, establishment of the major opportunities and threats for the company, while on the internal the focus was on Comtrade's strengths and weaknesses. Stakeholder analysis and BCG Matrix were completed in the process but are not included in the paper. Using SWOT and TOWS as inputs, we have developed the Quantitative Strategic Planning Matrix. As David et al. (2009), David (1986), Nasab and Milani (2012) highlighted the QSPM as an extraordinary instrument in the decision making process and choice among different strategies in addition to assisting managers understanding the internal and external environments that will help them make the most optimal and appropriate decisions regarding strategy and direction. By collaborated with industry professionals and obtaining insight from the Comtrade Group's management team we have determined the external and internal factor evaluation matrix, assigned weights and ratings in order to set priorities for the strategic planning and decision making processes.

4. EXTERNAL FACTORS EVALUATION

In order to strategically assess the firms position in the market and the external environment in general, PESTLE analysis (analyzing the political, economic, social, technological, legal and environmental factors) and Porter's five forces (where threat of new entrants, bargaining power of buyers, bargaining power of suppliers, threat of substitute products and services as well as the intensity of rivalry among the competitors in the industry were considered) were performed. Due to the extensive evaluation and findings, the analyses are not included in the paper. Nonetheless, the External Factor Evaluation matrix (Table 1.) reflects some of the major findings. The External Factor Evaluation matrix (abbreviated EFE) is valuable as it provides critical strategic business information to management regarding the company's standing in addition to enabling the prioritization, through rating, of the various opportunities and threat the company is facing. Factors listed in Table 1. were assigned weights and ratings. The weights, values ranging from zero to one, zero representing the low level of importance and one indicating a critical factor. Summed up, they should all add up to one. Ratings on the other hand indicate the degree to which the company is responding to the factors (similarly to weights, a lower value shows a poor response, while four, the highest possible value that can be assigned, an effective and efficient response). It is important to note that weights are considered at the industry level while the ratings at a national level.

As shown in Table 1, the customer need for new technologies adapted to the Serbian market is one of the most important opportunity factors for the company, in addition to the possibility of expanding to new markets. Comtrade has offices and development centers worldwide and is continuously seeking to adapt its offerings and services to meet the ever-growing need and demand. Increase of market share in the international market is one of the goals of the company. As resources become scarcer it is vital to support sustainable development and invest in alternate sources of power. Comtrade is committed to reducing negative environmental impact of their activities and to continuously improve their environmental performance as an essential and core part of their business strategy and operating methods. Therefore, the possibility of creating and using the possibilities of energy substitutes is critical.

Table 1: External Factors Evaluation Matrix for Comtrade Group

External Factors	Weight	Rating	Score
Opportunities:			
Customer need for new technologies adapted to Serbian market	0.11	4	0.44
Greater foreign investments in R&D of technology	0.01	2	0.02
Better law regulations for partnerships with foreign companies	0.05	3	0.15
Expansion to new markets	0.10	3	0.30
Increased market share in international market	0.08	2	0.16
Possibilities of energy substitutes	0.06	3	0.18
Entering new technology in market	0.05	3	0.15
Development of new technology (patents) by the company	0.06	3	0.18
Increased reputation and customer satisfaction from company's services and products	0.05	4	0.20
Collaborating opportunities with emerging start-ups and already established companies	0.04	2	0.08
Threats:			
High competition in IT industry	0.10	3	0.30
Rapidly changing trends	0.03	4	0.12
New regulations and laws	0.05	3	0.15
Established competitors	0.02	3	0.06
Different customer needs and trends in countries of operation	0.04	3	0.12
Changes in government policies and official stance toward foreign, partner, countries	0.03	3	0.09
Unexpected entry of large and more powerful competitor into the local market	0.05	2	0.10
Increased cost of being in business due to government environmental rules and regulations	0.02	3	0.06
Increased cost of labor and raw materials	0.05	3	0.15
Total	**1**	**-**	**3.01**

The company should seek to enter new technologies in market and develop an increasing number of patents and technologies. According to the data from the Intellectual Property Office of the Republic of Serbia (2013, 2015), only few patents from corporations and other business entities are being submitted each year, far less than private persons, creating a significant opportunity for the company. Comtrade has been increasing its reputation and customer satisfaction thanks to quality products and services. By collaborating with emerging start-ups and already established companies it can take advantage of newly created opportunities and be able to quickly adapt to changing market tastes, environment and competition. On the other hand, the high competition in the IT industry can be a significant threat along with the increasing costs of labor and raw materials, and changes in government policies and official stance toward foreign, partner, countries. Rapidly changing trends may become an issue, just like new laws and regulations, presence of established competitors, change in customer needs and trends in countries of operation. Unexpected entry of a large and more powerful competitor into the local market can also become a threat in addition to increased cost of being in business due to government environmental rules and regulations.

5. INTERNAL FACTORS EVALUATION

Following the external analysis, an internal evaluation of company's strengths and weaknesses was conducted. As can be observed in Table 2., after the assignment of weights and ratings to the individual factors, it was found that the factors that were deemed most influential were the company's proactive approach to innovation at local and global levels, its expertise in a variety of industries, certifications (ISO standards, employee certifications) and the excellent reputation among customers, in addition to one of the main weaknesses being the high fluctuation of engineering staff.

Table 2: Internal Factors Evaluation Matrix for Comtrade Group

Internal Factors	Weight	Rating	Score
Strengths:			
Strong brand name	0.06	4	0.24
Excellent reputation among customers	0.10	4	0.40
Certifications (ISO standards, employee certifications)	0.11	4	0.44
Good technology (both hardware and software)	0.08	3	0.24
Excellent employee knowledge	0.08	3	0.24
Expertise in a variety of industries (automotive, financial, energy, high-tech, gaming, public sector, etc.)	0.09	4	0.36
Committed to reducing negative environmental impact of company's business activities	0.02	3	0.06
Well established communication and network of customers and partners	0.05	4	0.20
Promotes innovation and is dedicated to educating younger generations (Fabrika znanja, EDIT, Girls in ICT)	0.05	3	0.15
Proactive innovation at local and global level	0.10	3	0.30
Large corporation but with a startup culture and approach when needed.	0.05	3	0.15
Weaknesses:			
High fluctuation of engineering staff	0.08	2	0.16
High R&D costs	0.03	2	0.06
Difficulties in penetrating new foreign markets	0.03	2	0.06
Complex network structure (company and employee level)	0.02	2	0.04
High frequency of ad-hoc changes on in-house projects	0.05	2	0.10
Total	**1**	**-**	**3.2**

6. SWOT & TOWS ANALYSIS

Following the external and internal analyses, SWOT and TOWS were performed to strategically assess the company's strengths, weaknesses, opportunities and threats. Table 3. features the SWOT analysis while the TOWS can be found in Table 4.

Table 3: SWOT analysis for Comtrade Group

STRENGTHS	**OPPORTUNITIES**
▪ Strong brand name ▪ Excellent reputation among customers ▪ Certifications (ISO standards, employee certifications) ▪ Good technology (both hardware and software) ▪ Excellent employee knowledge ▪ Expertise in variety of industries (automotive, financial, energy, high-tech, gaming, public sector, etc.) ▪ Committed to reducing negative environmental impact of company's business activities ▪ Well established communication and network of customers and partners ▪ Promotes innovation and is dedicated to educating younger generations (Fabrika znanja, EDIT, Girls in ICT) ▪ Proactive innovation at local and global level ▪ Large corporation but with a startup culture and approach when needed.	▪ Customer need for new technologies adapted to Serbian market ▪ Greater foreign investments in R&D of technology ▪ Better law regulations for partnerships with foreign companies ▪ Expansion to new markets ▪ Increased market share in international market ▪ Possibilities of energy substitutes ▪ Entering new technology in market ▪ Development of new technology (patents) by the company ▪ Increased reputation and customer satisfaction from company's services and products ▪ Collaborating opportunities with emerging start-ups and established companies
▪ High fluctuation of engineering staff ▪ High R&D costs ▪ Difficulties in penetrating new foreign markets ▪ Complex network structure (company and employee level) ▪ High frequency of ad-hoc changes on in-house projects	▪ High competition in IT industry ▪ Rapidly changing trends ▪ New regulations and laws ▪ Established competitors ▪ Different customer needs and trends in countries of operation ▪ Changes in government policies and official stance toward foreign, partner, countries ▪ Unexpected entry of large and more powerful competitor into the local market ▪ Increased cost of being in business due to government environmental rules and regulations ▪ Increased cost of labor and raw materials
WEAKNESSES	**THREATS**

Table 4: TOWS analysis for Comtrade Group

Internal / *External*	**Strengths:** 1. Good technology (both hardware and software) 2. Excellent employee knowledge 3. Expertise in a variety of industries (automotive, financial, energy, high-tech, gaming, public sector, etc.) 4. Certifications (ISO standards, employee certifications) 5. Proactive innovation at local and global level 6. Large corporation but with a startup culture and approach when needed	**Weaknesses:** 1. High R&D costs 2. Difficulties in penetrating new foreign markets 3. High fluctuation of engineering staff 4. High frequency of ad-hoc changes on in-house projects
Opportunities: 1. Customer need for new technologies adapted to Serbian market 2. Possibilities of energy substitutes 3. Development of new technology (patents) by the company 4. Collaborating opportunities with emerging start-ups and established companies 5. Expansion to new markets	**SO:** 1. Use existing good technology and employee knowledge to develop new technologies adapted to Serbian market (S1, S2, O1) 2. Bring new technology into the market by using excellent employee knowledge and expertise in variety of industries (O3, S2, S3) 3. Use expertise in a variety of industries to satisfy customer needs and expand to new markets (S3,O1, O5) 4. Expand to new markets by proactively innovating at local and global levels (S5, O5) 5. Take advantage of the firm's startup culture and approach in order to develop new technologies (S6, O3) 6. Use expertise in a variety of industries and certifications as significant resource in collaborating with other companies (O4, S4, S3)	**WO:** 1. Increase the possibility of penetrating new foreign market by working on new technology as energy substitutes (W2, O2, O3) 2. Reduce energy use and costs with energy substitutes in order to render R&D more cost efficient (O2, W1) 3. Decrease R&D costs by adapting company's existing technology to the Serbian market (W1,O1) 4. Reduce high fluctuation of engineering staff by collaborating with emerging start-ups and established companies (W3, O4) 5. Use the development of new technology (patents) by the company to retain engineering staff (W3, O3) 6. Increase project management capabilities for in-house projects in order to more effectively penetrate new markets (W4, O5)
Threats: 1. High competition in IT industry 2. Increased cost of being in business due to new government environmental rules and regulations 3. Increased cost of labour and raw materials 4. Rapidly changing trends 5. Different customer needs and trends in countries of operation	**ST:** 1. Reduce costs of business induced by new environmental regulations by engaging excellent employee knowledge and expertise in variety of industries (T2, S2, S3) 2. Work on competitiveness in IT industry by combining company's good technology and expertise in variety of industries (T1, S1, S3) 3. Use expertise in variety of industries to readily face rapidly changing trends and meet different customer needs (T4, T5, S3) 4. Face increased cost of labour and raw materials by proactively innovating at local and global levels (T3, S5)	**WT:** 1. Look for ways to reduce R&D costs in order to beat competition (T1, W1) 2. Advance the possibility of penetrating new foreign markets by establishing partnerships with companies in countries with lower labor and/or raw material costs (W2, T3) 3. Keep up with the rapidly changing trends by structuring in-house projects in a more efficient manner (W4, T4) 4. Reduce the high fluctuation of engineering staff in order to rise competitiveness in the industry (W3, T1)

7. IMPLEMENTATION OF QSPM AND FINAL RESULTS

The results of SWOT analysis, external and internal factors with their weights are presented in the first column of the QSPM (Table 5). The information was directly derived from EFE and IFE matrix. The AS field indicates the Attractiveness Score. Attractiveness Score is obtained through the consideration of the critical success factors and asking the following question: "Do these factors affect the choice of strategy?" (Hamidi & Delebahari, 2011). Four experts from Comtrade Group were questioned, and attractiveness scores were calculated as the average value of their individual scores given in the following form: No attractiveness - 0 score, little attractiveness - 1 score, almost attractive - 2 scores, acceptable attractiveness - 3 scores and high attractiveness - 4 scores. The FAS indicates the Final Attractiveness Score, obtained by multiplying the factor weight and attractiveness score.

Table 5: Quantitative Strategic Planning Matrix (QSPM) for Comtrade Group

		SO-1		SO-2		SO-3		SO-4		SO-5		SO-6		ST-1		ST-2		ST-3		ST-4	
Factor	Weight	AS	FAS	AS	FAS	AS	FAS	AS	FAS	AS	FAS	AS	FAS	AS	FAS	AS	FAS	AS	FAS	AS	FAS
O1	0.11	4	0.44	3	0.33	4	0.44	2	0.22	2	0.22	1	0.11	-	-	3	0.33	4	0.44	-	-
O2	0.06	-	-	2	0.12	-	-	3	0.18	3	0.18	2	0.12	4	0.24	3	0.18	1	0.06	4	0.24
O3	0.06	3	0.18	4	0.24	3	0.18	4	0.24	4	0.24	3	0.18	3	0.18	4	0.24	1	0.06	4	0.24
O4	0.04	2	0.08	3	0.12	2	0.08	3	0.12	3	0.12	4	0.16	1	0.04	1	0.04	2	0.08	3	0.12
O5	0.10	3	0.30	4	0.40	4	0.40	4	0.40	3	0.30	2	0.20	-	-	3	0.30	4	0.40	1	0.10
T1	0.10	3	0.30	3	0.30	3	0.30	4	0.40	3	0.30	3	0.30	3	0.30	4	0.40	3	0.30	2	0.20
T2	0.02	-	-	-	-	-	-	1	0.02	1	0.02	1	0.02	4	0.08	2	0.04	1	0.02	2	0.04
T3	0.05	-	-	2	0.10	2	0.10	1	0.05	2	0.10	1	0.05	3	0.15	2	0.10	1	0.05	4	0.20
T4	0.03	3	0.09	3	0.09	3	0.09	4	0.12	3	0.09	2	0.06	-	-	2	0.06	4	0.12	1	0.03
T5	0.04	3	0.12	4	0.16	4	0.16	4	0.16	3	0.12	3	0.12	1	0.04	2	0.08	4	0.16	1	0.04
S1	0.08	4	0.32	3	0.24	2	0.16	4	0.32	3	0.24	3	0.24	2	0.16	4	0.32	2	0.16	2	0.16
S2	0.08	4	0.32	4	0.32	4	0.32	4	0.32	4	0.32	4	0.32	4	0.32	4	0.32	3	0.24	2	0.16
S3	0.09	3	0.27	4	0.36	4	0.36	4	0.36	3	0.27	4	0.36	4	0.36	4	0.36	4	0.36	2	0.18
S4	0.11	2	0.22	3	0.33	3	0.33	2	0.22	3	0.33	4	0.44	3	0.33	4	0.44	1	0.11	1	0.11
S5	0.10	3	0.30	4	0.40	4	0.40	4	0.40	4	0.40	3	0.30	2	0.20	4	0.40	3	0.30	4	0.40
S6	0.05	3	0.15	3	0.15	3	0.15	3	0.15	4	0.20	3	0.15	2	0.10	3	0.15	1	0.05	3	0.15
W1	0.03	2	0.06	2	0.06	2	0.06	2	0.06	2	0.06	3	0.09	3	0.09	2	0.06	-	-	1	0.03
W2	0.03	3	0.09	4	0.12	4	0.12	4	0.12	3	0.09	2	0.06	2	0.06	2	0.06	4	0.12	1	0.03
W3	0.08	2	0.16	2	0.16	-	-	1	0.08	3	0.24	1	0.08	-	0.08	1	0.08	-	-	1	0.08
W4	0.05	2	0.10	2	0.10	1	0.05	1	0.05	2	0.10	1	0.05	1	0.05	1	0.05	1	0.05	-	-
Total			**3.50**		**4.10**		**3.70**		**3.99**		**3.94**		**3.41**		**2.78**		**4.01**		**3.08**		**2.62**

		WO-1		WO-2		WO-3		WO-4		WO-5		WO-6		WT-1		WT-2		WT-3		WT-4	
Factor	Weight	AS	FAS	AS	FAS	AS	FAS	AS	FAS	AS	FAS	AS	FAS	AS	FAS	AS	FAS	AS	FAS	AS	FAS
O1	0.11	1	0.11	-	-	4	0.44	-	-	-	-	2	0.22	1	0.11	1	0.11	2	0.22	-	-
O2	0.06	4	0.24	4	0.24	-	-	-	-	-	-	1	0.06	4	0.24	3	0.18	-	-	-	-
O3	0.06	4	0.24	3	0.18	2	0.12	2	0.12	4	0.24	2	0.12	2	0.12	3	0.18	1	0.06	-	-
O4	0.04	1	0.04	1	0.04	2	0.08	4	0.16	-	-	1	0.04	3	0.12	4	0.16	1	0.04	1	0.04
O5	0.10	4	0.40	-	-	-	-	-	-	-	-	4	0.40	1	0.10	4	0.40	-		-	-
T1	0.10	2	0.20	2	0.20	1	0.10	3	0.30	3	0.30	1	0.10	4	0.40	3	0.30	1	0.10	4	0.40
T2	0.02	3	0.06	4	0.08	-		-	-	-	-	-	-	4	0.08	1	0.02	-	-	-	-
T3	0.05	2	0.10	4	0.20	1	0.05	1	0.05	1	0.05	-	-	1	0.05	4	0.20	1	0.05	1	0.05
T4	0.03	1	0.03	-	-	-	-	1	0.03	1	0.03	1	0.03	1	0.03	-	-	4	0.12	3	0.09
T5	0.04	1	0.04	-	-	2	0.08	-	-	-	-	-	-	-	-	1	0.04	1	0.04	-	-
S1	0.08	1	0.08	2	0.16	1	0.08	1	0.08	1	0.08	2	0.16	2	0.16	3	0.24	1	0.08	-	-
S2	0.08	1	0.08	1	0.08	2	0.16	1	0.08	1	0.08	2	0.16	2	0.16	1	0.08	1	0.08	1	0.08
S3	0.09	2	0.18	1	0.09	2	0.18	1	0.09	2	0.18	1	0.09	2	0.18	2	0.18	1	0.09	1	0.09
S4	0.11	1	0.11	1	0.11	-	-	2	0.22	1	0.11	1	0.11	-	-	-	-	-	-	2	0.22
S5	0.10	3	0.30	1	0.10	2	0.20	1	0.10	2	0.20	2	0.20	3	0.30	1	0.10	1	0.10	2	0.20
S6	0.05	1	0.05	1	0.05	1	0.05	2	0.10	1	0.05	3	0.15	3	0.15	1	0.05	3	0.15	3	0.15
W1	0.03	3	0.09	4	0.12	4	0.12	-	-	1	0.03	4	0.12	4	0.12	3	0.09	1	0.03	1	0.03
W2	0.03	4	0.12	-	-	-	-	-	-	-	-	2	0.06	1	0.03	4	0.12	-	-	-	-
W3	0.08	-	-	-	-	-	-	4	0.32	4	0.32	1	0.08	-	-	-	-	2	0.16	4	0.32
W4	0.05	-	-	1	0.05	-	-	2	0.10	1	0.05	4	0.20	2	0.10	-	-	4	0.20	2	0.10
Total			**2.47**		**1.70**		**1.66**		**1.75**		**1.72**		**2.30**		**2.45**		**2.45**		**1.52**		**1.77**

Based on the results obtained from the Quantitative Strategic Planning Matrix, (total values for each strategy as a sum of FAS values), priorities can be determined and ranked. The prioritized list of strategies is as follows:

1. Bring new technology into the market by using excellent employee knowledge and expertise in a variety of industries (SO2: 4.10)
2. Work on competitiveness in the IT industry by combining company's good technology and expertise in variety of industries (ST2: 4.01)
3. Expand to new markets by proactively innovating at local and global levels (SO4: 3.99)
4. Take advantage of the firm's startup culture and approach in order to develop new technologies (SO5: 3.94)
5. Use expertise in a variety of industries to satisfy customer needs and expand to new markets (SO3: 3.70)

6. Use existing good technology and employee knowledge to develop new technologies adapted to Serbian market (SO1: 3.50)
7. Use expertise in a variety of industries and certifications as significant resource in collaborating with other companies (SO6: 3.41)
8. Use expertise in variety of industries to readily face rapidly changing trends and meet different customer needs (ST3: 3.08)
9. Reduce costs of business induced by new environmental regulations by engaging excellent employee knowledge and expertise in variety of industries (ST1: 2.78)
10. Face increased cost of labor and raw materials by proactively innovating at local and global levels (ST4: 2.62)
11. Increase the possibility of penetrating new foreign market by working on new technology as energy substitutes (WO1: 2.47)
12. Look for ways to reduce R&D costs in order to beat competition (WT1: 2.45)
    Advance the possibility of penetrating new foreign markets by establishing partnerships with companies in countries with lower labor and/or raw material costs (WT2: 2.45)
13. Increase project management capabilities for in-house projects in order to more effectively penetrate new markets (WO6: 2.30)
14. Reduce the high fluctuation of engineering staff in order to rise competitiveness in the industry (WT4: 1.77)
15. Reduce high fluctuation of engineering staff by collaborating with emerging start-ups and established companies (WO4: 1.75)
16. Use the development of new technology (patents) by the company to retain engineering staff (WO5: 1.72)
17. Reduce energy use and costs with energy substitutes in order to render R&D more cost efficient (WO2: 1.70)
18. Decrease R&D costs by adapting company's existing technology to the Serbian market (WO3) - 1.66
19. Keep up with the rapidly changing trends by structuring in-house projects in a more efficient manner (WT3: 1.52)

8. CONCLUSION

A company's success in the market largely depends on a carefully designed and developed strategy (Schilling, 2013). Technology strategy includes the objectives, strategies and tactics related to development and application of technologies within an organization (Floyd & Wolf, 2010). Formulating a technology strategy that will enable the company to assess its current position and determine its future orientation by taking advantage and focusing on its core competences is critical (Schilling, 2013). Comtrade Group, recognized the need of assessing and prioritizing its strategies, and performed evaluation and selection of technology strategies by using the Quantitative Strategic Planning Matrix.

The SWOT and TOWS analyses, crowned by the QSPM evaluation, clearly showed great possibilities for Comtrade's further development of its business by bringing in and developing new technology both in the Serbian as well as foreign markets. The principal strategy derived from the Quantitative Strategic Planning Matrix was to "bring new technology into the market by using excellent employee knowledge and expertise in a variety of industries". According to findings from the QSPM analytics tool, by focusing on its core competences and taking advantage of the extensive knowledge of its employees and company's experience in a wide array of industries ranging from medical, public sector, government, telecommunications, automotive, finance and travel to gaming and hospitality industries, Comtrade will be able to thrive, strengthen its position as a leader in IT and successfully expand into new markets. Further research is needed to confirm the relation between the QSPM prioritized strategy ranking and company's increased efficiency, profitability or success in the market.

9. ACKNOWLEDGEMENTS

We would like to thank the Comtrade Group team for their invaluable support and collaboration, with special thanks to the president of Comtrade Group, Mr. Veselin Jevrosimović, adviser to the president Mr. Srećko Miodragović, Chief Technology Officer of Internet Group Mr. Miloš Marčeta, and Director of Human Resources Department Ms. Tanja Perić. Furthermore, we would like to express our deepest gratitude to the University of Belgrade, Faculty of Organizational Sciences, faculty and colleagues.

REFERENCES

Burgelman, R. A., & Wheelwright, S. C. (2004). Strategic management of technology and innovation. *READING*, *1*(1).

Comtrade. (2015). Simplify technology. Retrieved November 16, 2015 from http://www.comtrade.com/

David, F. R. (1986). The strategic planning matrix—a quantitative approach. Long Range Planning, 19(5), 102-107.

David, M. E., David, F. R., & David, F. R. (2009). The Quantitative Strategic Planning Matrix (QSPM) applied to a retail computer store. The Coastal Business Journal, 8(1), 42-52.

Floyd, S.W. & Wolf, C. (2010) 'Technology Strategy' In: Narayanan, V.K. & O'Connor, G.C. (eds.) Encyclopedia of technology and innovation management. West Sussex: Wiley, 125–128.

Hamidi, K. & Delbahari, V. (2011) Formulating a Strategy for a University Using SWOT Technique: A Case Study, Australian Journal of Basic and Applied Sciences, 5(12):264-276.

Henriksen, A.D. & Traynor, A.J. (1999). A Practical R&D Project Selection Scoring Tool. IEEE Transactions on Engineering Management, Vol.46, No.2,158-170.

Intellectual Property Office. (2013). Patent Sector Report for 2013. Retrieved April 17, 2016 from http://www.zis.gov.rs/upload/documents/pdf_en/pdf_patenti/Patents_report_2013_eng.pdf.

Intellectual Property Office. (2015). Statistics - Patents. Retrieved April 17, 2016 from http://www.zis.gov.rs/upload/documents/pdf_sr/pdf_patenti/Statistika_Patenti_2006_2015.pdf.

Nasab, H. H., & Milani, A. S. (2012). An improvement of quantitative strategic planning matrix using multiple criteria decision making and fuzzy numbers. Applied Soft Computing, 12(8), 2246-2253.

Schilling, M. A. (2013). Strategic management of technological innovation, 4th edition. Boston: McGraw-Hill.

Tan, K. H., Noble, J., Sato, Y., & Tse, Y. K. (2011). A marginal analysis guided technology evaluation and selection. International Journal of Production Economics, 131(1), 15-21.

OPPORTUNITIES AND THREATS OF GLOBAL TECHNOLOGY AND OPERATIONS STRATEGY IN OIL AND GAS INDUSTRY

Ivan Sekulović
Faculty of Organizational Sciences
e-mail: ivan.sekulovic82@gmail.com

Abstract: *Oil & gas industry in the era of globalization faces various opportunities and threats. Opportunities and threats are generated by different factors. Oil & gas industry represents driving force and is vital to all other economy branches. Although it is driven by supply and demand forces, it can influence them significantly. Due to limited reserves at home, majority of companies run their operations internationally and globally. Global approach gives wide range of opportunities, but it also imposes threats. This research concerns a range of global strategic approaches directed to use maximum opportunities and to overcome the threats. Used materials originate from international, global and national oil & gas companies websites. Research method is based on common theoretical approaches to international and global business strategies. Main conclusions and proposals of this research are necessity of transformation of companies into energy holdings and implementing new business models and broadening portfolio of products.*

Keywords*: opportunities, threats, oil & gas industry, energy, transformation, diversification, energy efficiency*

1. INTRODUCTION

Modern business operations in 21st century obtained global scales. Globalization as main trend in modern business is getting strength by removing trade barriers, standardization of production and neoliberal concept of economy. Large corporations take leading role in shaping world's economy.

The essential branch of every country's economy is its energy sector and the heart of the energy sector is oil & gas industry. It represents driving force for almost all other industries in the economy. Thus, oil & gas industry is considered as strategic one for every country's economy as well as the economy of the whole world.

Majority of leading oil & gas companies are internationally and globally oriented. International and global orientation of oil & gas companies is caused by various reasons such as limited resources of hydrocarbons in their home countries or conquering new markets and increasing market share and market growth.
As internationally and globally oriented, oil & gas companies need to implement strategies for coordinating business activities with the aim of improving their operations and technology as one of the main functions in modern companies' value chain.

The main objective of this research is global strategy and strategic approaches in technology and operations of oil & gas companies, the opportunities and challenges they face in running their businesses. In accordance to the main objective, following hypothetical framework of this research can be set:

1. *General hypothesis* is the necessity of oil & gas companies for transformation to energy holdings by introducing new business activities into value chain.
2. *First special hypothesis* is that oil & gas companies should improve energy efficiency since they are both energy producers, but also large energy consumers.
3. *Second special hypothesis* the necessity of oil & gas companies to use the unconventional hydrocarbons sources.
4. *Third special hypothesis* is the necessity of oil & gas companies to invest into R&D activities in the field of technology of using the unconventional resources of hydrocarbons, as well as the renewable energy resources.

The scope of this research is based on common theoretical approach to global strategy applied to oil & gas industry. It is limited to the operations of key international players in oil & gas industry (BP, Shell, Exxon Mobil, Gazprom etc.) and some national oil companies (Sonangol – Angola, NIS – Serbia, CNPC – China etc.). Limitations were also reflected in the impossibility to access to strategic documents of majority of the

companies as they are treated as confidential. Main conclusions had to be made from separate actions of the companies described on their relevant websites or elsewhere.

The research paper is divided into two main parts:

1. Global Business in Oil & Gas Sector, which provides main features of oil & gas industry as well as global business operations in it. Opportunities and threats of global operations in oil & gas sector are presented and described within this part.
2. Possible Solutions and Concluding Remarks, which represent a discussion on possibilities for oil & gas industry to improve growth and continue the business activities seizing the opportunities and avoiding threats and conclusions.

2. GLOBAL BUSINESS IN OIL & GAS SECTOR

2.1. Main Features of Oil & Gas Industry

Everyday life of millions of contemporary men and women all over the world hardly can be imagined without driving a car. Good and effective heating is also one of the essential requirements of modern world. Everyday shopping is almost impossible without plastic (nylon) bags. What makes connection between mentioned, on the first sight, separated segments of everyday life?

A car needs to be loaded with gasoline in order to perform its function. The most effective heating at relatively low cost can be achieved only using natural gas. Plastic bags are made mostly of nylon. All the three products are just a small part of large gamma of production of oil & gas industry. These examples just illustrate the fact that oil & gas industry plays one of the most significant roles in modern world.

Oil & Gas industry has vital significance to many other industries. Majority of economy branches are directly or implicitly dependent of it. Thus it is of great importance for the industrial civilization on the whole. On the national level oil & gas industry often is considered as strategic one and as such it represents critical concern for many nations. For that reason activities in oil & gas industry are often being planned both by the states and by companies. Strategic planning both on company and on state level will be further considered in this research paper.

In order to consider strategies in oil & gas sector, it is essential to understand main activities of the industry. One way of describing them is through the industry's value chain. The American Petroleum Institute divided oil & gas industry into five main business sectors: upstream, downstream, pipeline, marine, service & supply (www.api.org). Having in mind that marine may be related to upstream activities, service & supply to both upstream and downstream, and pipeline to transportation, oil & gas business is commonly divided as follows:

- upstream;
- midstream;
- downstream.

Upstream is related to exploration, development and production of crude oil and natural gas. Midstream refers to transportation of crude oil and processing and transportation of natural gas to the refining facilities or final consumers respectively. Downstream activities in oil & gas sector relate to refining and sales & marketing.

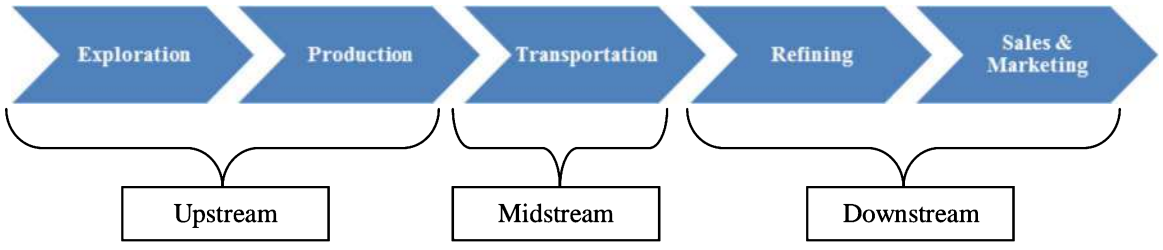


Figure 1: Value Chain of Oil Industry

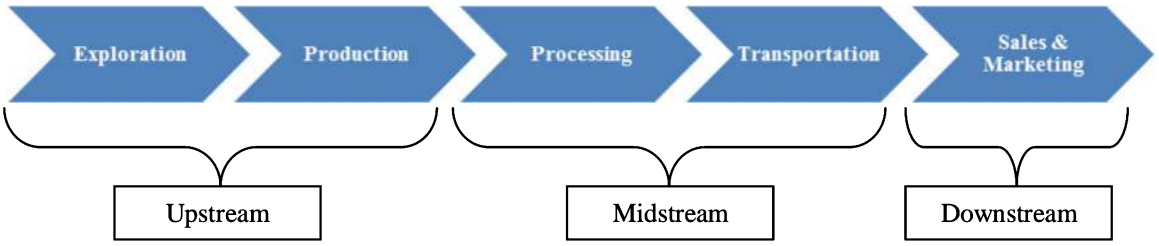


Figure 2: Value Chain of Natural Gas Industry

It is worth of mentioning that world's largest and leading oil & gas companies are fully vertically integrated, which means that they cover all of the activities of the industry value chain. Some of them are Royal Duch / Shell (Netherlands), BP Corporation (United Kingdom), Exxon Mobil Corporation (USA), National Iranian Oil Company (Iran), OAO Gazprom (Russian Federation), Petroleo Brasileiro S.A. (Brasil), Sonangol (Angola) etc.

2.2. Global Orientation and National Responsiveness of Oil & Gas Companies

Key players in modern energy sector, particularly in oil & gas, run their businesses globally. Majority of largest oil & gas companies form their resource bases by dislocating their upstream sectors overseas. Others increase refining facilities or broaden their sales and distribution networks by acquiring foreign companies or making strategic alliances with them.

Recently oil & gas sector has been facing growing demand for energy globally. According to recent research conducted for Bank of Scotland 77% of executives in oil & gas industry were planning company growth in 2013 and 2014 (White, 2013). Majority of growing companies especially those that are engaged in upstream and oilfield services act globally. They are predominantly oriented to emerging markets, especially those in Russia, South America and Far East (bordering area between China and Vietnam) as well as underdeveloped markets, such as those in Africa.

Oil & gas corporations usually benefit from economy of scale even at small local markets. As can be seen from above mentioned, companies that deployed their business in upstream activities of the industry value chain can act in different parts of the globe. Main reason for that is high standardization of exploration and production technologies and required equipment. Differentiation of services is unimportant and even negligible. Concerning the upstream sector, companies engaged in it may implement and apply global strategic approach. Centralized planning of operations as well as R&D activities in the field of technology can bring significant results. Still, some activities require specific approach for every region and even every country. More than 975 thousand millions of barrels of oil and 100 trillion cubic meters of natural gas (BP, 2013) which represent the biggest part of proved oil & gas reserves are allocated in emerging and underdeveloped countries. Main challenges of performing exploration and production activities as well as oilfield services are often political and legislative obstacles. Political obstacles such as violent changes of the regime, civil wars and other kinds of clashes can seriously jeopardize activities of foreign companies in the host country. The most recent example was Libya. Due to the escalation of violence in that country, some European companies were forced to abandon their equipment, which remained in Libya. Besides the losses of profit, the companies faced the loss of capital as well. Legislative obstacles are often the issues with property and property rights due to instable laws and regulations. Since oil & gas reserves have strategic significance for the host country, their nationalization by the government can represent serious challenge for operating company.

On the other hand, companies that are predominantly engaged in downstream sector (oil refining and sales and marketing) may face some challenges in implementing and applying global strategy. Companies like Kuwait Petroleum International (known by its trademark Q8) that are involved in downstream activities outside of their home countries usually face differences in particular quality standards or environment protection regulations in various countries or regions. Although these companies also benefit from economy of scale they have to take into consideration also national responsiveness in their approach to every particular market. National responsiveness approach in oil & gas field requires feasibility studies which include studies of legislature, standards and regulations concerning oil and gas refining and distribution of the host country, as well as culture and requirements of consumers. Apart from quality standards and safety

regulations, a company should respond to the requirements in regards with palette of additional products sold on petrol stations as well. They may implicitly refer to the climate conditions of particular country or region, or standard of living.

In case of companies predominantly involved in upstream activities, global strategy approach may be more centralized. It may provide more precise instructions to company's branches overseas about operations and technology they use. In other words, global strategy should set standards and regulations regardless of the region or country where company's branch operates. These standards and regulations often are adopted by other companies operating in the same region or country as well as by the legislature bodies of the host country.

In case of companies, which perform downstream operations overseas, national responsiveness approach should be dominant. Their global strategy should provide just basic guidelines for doing business. Decision making in these companies should be more decentralized and overseas branches must have certain autonomy in planning their operations. Special attention should be paid on making decisions of technology the company branch will use. Selected technology must cope with local standards especially in the field of pollution reduction and quality of fuel produced. The choice of technology should respond to the issues of origin and type of crude oil that is to be refined. Different types of oil require different technology approaches to their refining.

Planning sales and marketing activities must be decentralized to the highest extent. Consumers in different locations, however, have different level of brand awareness for certain brands, as well as different preferences.

In both cases global strategy should be implemented with different extents of integration of business. In case of upstream business integration can be made to the large extent, having in mind the nature of business and possibility of technology and operations standardization. In case of downstream activities, the level of integration is, expectedly, low.

2.3. Opportunities of Appliance of Global Technology and Operation Strategy in Oil & Gas Industry

Oil & Gas industry represents the most significant part of energy industry value chain. This industry is capital intensive and, what is more important, energy intensive industry. On one hand, oil & gas industry is the largest supplier of energy all around the globe, but on the other hand it is also a large energy consumer. In the past few decades, oil & gas companies invested a lot into R&D activities in order to decrease energy consumption in some parts of its value chain. In other words, most of oil & gas companies have been committed to implementation of energy efficiency projects. Due to advanced technologies, such as mild hydrocracking (MHC) or reduction of flaring of gas, refining sector demonstrated significant decrease in energy consumption. According to Global Gas Flaring Reduction partnership in the period between 2005 and 2010, flaring of gas associated with oil production has decreased by 22% all around the world (Accenture, 2012). Other sectors of oil & gas industry predominantly upstream may also see the opportunity in energy efficiency, since in this sector energy consumption has increased recently. The increase in energy consumption in upstream activities can be easily understood having in mind that oil & gas reserves are limited. As the time passes by, conventional oil & gas resources are being exhausted due to heavy extraction. Extracting the hydrocarbons from mature fields requires more energy consumption and is becoming more and more difficult.

As the main energy supplier, oil & gas industry is facing increasing demand for energy on the whole. Consumer demand for energy is predominantly driven by the countries with the emerging economies. It is estimated that by 2035 a number of passenger cars all over the world will reach 1.7 billion! Consequently, oil consumption will increase significantly. Majority of these end-consumers will come from non-OECD countries (Accenture, 2012).

This situation makes extraordinary background for planning and deploying operations overseas. As it was mentioned before, major players on oil & gas market started their upstream operations overseas. Main reasons for that usually are: the lack of oil reserves at home or low quality of hydrocarbons or preventing competitors to obtain access to oil and gas rich reserves in other territories.

Increasing number of end-consumers in emerging countries makes international oil & gas companies think on deploying their downstream operations to those countries. Downstream activities, both sales and

distribution and refining and processing make an opportunity of conquering new markets. Seizing this opportunity, a company may work on its revenue growth by collaboration with host country government and local companies to create and develop new markets or improve the existing ones and possibly open new sales and marketing channels. Working in new environment, the company will also be able to create new business models. Considering and adopting new business models can improve company's global strategic approach through decentralization of governance and making business decisions more independently and more efficiently.

One of the most important goals of applying of global strategy is cost reduction. Cost reduction can be achieved in various ways such as moving production to the regions with inexpensive labor or with weak HSE standards. Still, cost reduction can be achieved to significant extent by implementing energy efficient and waste reduction technologies in both exploration & production and refining processes in all globally deployed activities. Investment in innovation and successful technology management represent key factors for cost reduction.

Oil & gas industry shows deep devotion to innovation and creation of new technologies. There are several existing directions of innovation in oil & gas industry. One of them is creating of fully digitalized oil field which is covered with the most sophisticated information technology and systems of monitoring (Bigliani, 2013). Significant results have already been achieved in the field of innovation, but still much remains to be done. With possibility of transferring every operation from industry value chain overseas, oil & gas companies become global players in energy supply system. Yet, transferring the operations in modern business means transfer of technology. Since oil & gas companies are oriented to economy of scale, they have to standardize their operations both at home and overseas. Standardization is one of the basic requirements of quality management and quality control. Standardization further requires transferring of certain technology to newly obtained production or refining facilities or from them. Transfer of advanced technologies to less developed countries offers benefits both to the company and to host country. The company will probably be the first to use advanced technology in that country or region and will obtain competitive advantage on the local market. On the other hand host country will improve its industry and economy on the whole often improving its environmental standards which will be beneficial for the whole society.

One of the opportunities in that field also is partnership between national oil companies and international oil companies. NOC-IOC partnership usually provides experienced management of oilfields and expertize in operations. National oil companies usually benefit from government protection and often artificially increased prices of fuel. They have easy or even exclusive access to local oilfields and reservoirs as well. By creating partnering relationships with national oil companies, the international oil companies may also obtain some governmental benefits from local governments through their local partners. Forming strategic alliances with NOCs or entering joint ventures with them, the IOCs may obtain the access to the oil fields and perform activities that previously were exclusive right of NOCs. National oil companies may see the opportunity in joint ventures or other partnering relationships with international oil companies, in financing innovative projects, obtaining the access to advanced technologies and knowledge exchange. NOC-IOC partnerships can be successful in joint ventures on other "neutral" territories. An example of such successful partnership is development of Rumaila field in Iraq, performed by China National Petroleum Corporation (CNPC) and British Petroleum (BP, 2013).

An opportunity of contemporary global business in oil & gas sector can be seen in acquisitions and strategic alliances. By entering such models of business cooperation, oil & gas companies can gain new capabilities or improve the existing ones. They open new growth opportunities to the companies in the environment of increasing competitiveness, Expanding supply base, gaining access to new consumer markets, increase in market share or even obtaining significant market power are some of the benefits for companies entering in such ventures. One of the most recent examples for acquisition is Royal Duch / Shell acquisition of Repsol LNG assets outside North America. By this acquisition Royal Duch / Shell will now undertake additional 7.2 million tonnes per year of directly managed liquefied natural gas (LNG) supply in the Atlantic from Trinidad and Tobago and in Pacific from Peru (Oil & Gas Journal, 2014).

In addition to previously mentioned items, there is also an opportunity of accessing new process and product technologies, know-how or advanced state-of-the art technological approaches. Good example for that may be Technip acquisition of Stone & Webster process technologies and associated oil & gas engineering capabilities from the Shaw Group. By this transaction Technip will strengthen its position as technology provider to the refining and petrochemical industries. It will also diversify its onshore / offshore segment adding revenue based on technology supply. Technip has an opportunity to strengthen its relationships with clients and partners worldwide backed by Stone and Webster reputation. Expanding growth areas as the US with strong downstream markets that will benefit from the supply of unconventional gas is also an important gain of Technip. Finally skilled resources will be added to Technip in research in the US and engineering and

research in the UK and India. The newly acquired business is spread in the US (Texas and Massachusetts), the UK (Milton Keynes) and India (Mumbai). The acquired business generates revenues predominantly from technology licensing and process design engineering (Technip, 2012).

Possibly the most important opportunity of modern oil & gas industry can be the exploration and use of the unconventional sources of oil & gas. As it was mentioned above, traditional extraction from existing and mature oilfields becomes more and more expensive, as hydrocarbons reserves are constantly decreasing. The unconventional sources, such as oil sands, heavy or extra heavy oil or shale gas represent revolutionary opportunity for oil & gas companies to improve competitiveness in modern markets. Extraction and production of hydrocarbons from the unconventional resources requires the use of advanced technologies, which have already been developed to the certain extent. Main problems of processing the unconventional resources still are waste of energy and higher costs of exploration and production activities. The unconventional resources are deployed all around the globe.

The largest resource base of shale gas, for example, is in China with the approximate quantity 1,275 trillion cubic feet (TCF). China is followed by USA and Argentina with approximate quantities 862 TCF and 774 TCF respectively. Figure 3 shows approximate quantities of the shale gas per country (Chemistry Views, 2012).
Besides new technologies, main requirements for global players in oil & gas industry are improvement of global strategic approaches in obtaining the access to the reserves but also global management of technology, as the unconventional resources operations are technology intensive and deployed all over the world.

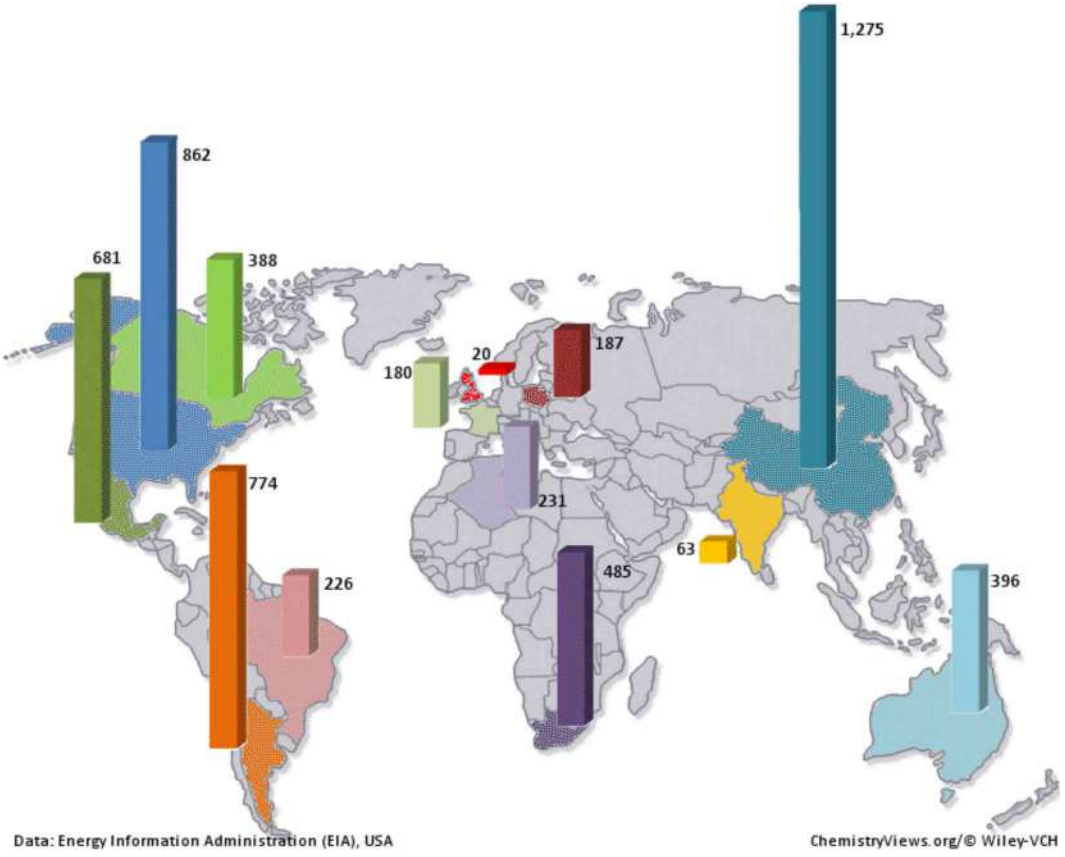


Figure 3: Approximate quantities of shale gas per country
Source: www.chemistryviews.org, based on EIA (USA)

Above presented and explained opportunities are just a segment of global opportunities which are growing and will be growing in the future. The process of globalization and increasing investments in R&D are constantly opening new opportunities in oil & gas industry.

2.4. Threats of Appliance of Global Technology and Operation Strategy in Oil & Gas Industry

Apart from great opportunities, oil & gas business carries certain challenges and risks as well. When considering threats, obvious fact that must be taken into account is that oil & gas industry deeply depends on government policies and attitudes.

Political instability in certain regions of the world represents substantial threat for investments and operations in oil & gas sector. In recent years the world witnessed the most extreme kind political instability in some oil & gas rich regions (e.g. Middle East or Northern Africa) causing even armed clashes and wars. The risks of such kind of political instability are well known. Companies that operate in those regions can be affected by losing return of investments, profit and capital. On the other hand prices of crude oil increase and subsequently end-consumers suffer oil products price increase as well.

Other types of political instability can refer to lack of strong legislation in the host country which may affect company's business on the whole in that particular country. Companies usually may face problems with the property rights in emerging and underdeveloped countries and problems with intellectual property protection. Property rights issues can jeopardize direct investments and building facilities in the host country. Yet, intellectual property rights issues usually affect R&D activities and technology transfer.

Another threat that can be referred to the politics is increasing role of government in managing the oil & gas resources. In planning operations and risk management activities it is substantial to take into account the fact that oil & gas products are strategically important products ones for every country in the world. It was mentioned before that oil & gas industry drives majority of other industries and this fact may lead to the conclusion that the greatest part of country's economy depends on oil & gas industry. One of the natural risks of oil & gas sector is decreasing amount of oil reserves in the world. This is serious threat not only to oil & gas companies but to their consumers as well.

Legislative threats derived from this natural risk are series of energy efficiency policies. These policies are being implemented in other economy sector, such as automobile industry, civil engineering and construction and many other industries with energy intensiveness as one of main features. They can be imposed as regulations or some incentives can be offered to the companies that implement new energy efficiency standards. Direct consequences of implementation energy efficiency policies affect consumption of fuels for operating passenger cars and other vehicles or heating. It further influences decreasing demand for fossil fuels and affects profit of oil & gas companies.

Although energy efficiency implementation can be considered as an opportunity for oil & gas industry as energy consumer and even as strong financial incentive for the industry, it is serious threat for oil & gas industry as an energy supplier.

Health, safety and environment issues represent key challenges for managing global operations in oil & gas industry. Oil & gas production and refining facilities are traditionally considered as high polluters. High level of pollution and lack of environmental friendly technologies invoked public debates and oil & gas companies are often target of attack of various global ecology organizations. More serious consequences of neglecting HSE issues may be explosion and huge scale of pollution in region which an oil & gas company operates in. Explosion of Deepwater Horizon drilling rig in Gulf of Mexico in 2010, Pemex pipeline explosion in 2012 and Amuay Refinery explosion and shutdown are just some of the most extreme examples of disasters concerning HSE issues. For Deepwater Horizon drilling rig explosion was claimed responsible by Greenpeace and criticized by many other organizations concerned with environmental protection (Bigliani, 2013).

HSE issues can cause a wide range of consequences for oil & gas companies from endangering their reputations by being criticized publicly because of explosions causing ecology catastrophes and even losses of human lives.

Rising threat for traditional oil & gas industries comes from new technologies and fossil fuel substitutes on the market. Launching new electric car models as alternative cars by BMW, Ford, Mitsubishi and many others in the future will probably invoke decrease of demand for fossil fuels. Recently founded company Tesla Motors produces exclusively electric vehicles. Production of electric vehicles is emerging branch of automobile industry in China as well. Apart from electric power used instead of fossil fuel, there are another types of fuel used in transportation sector. Biodiesel is one of alternative fuels that can be considered as substitute to traditional fossil fuels. It is typically produced by chemically reacting lipids with an alcohol. It is widely used in many European cities in public transportation sector.

In heating buildings and private houses all over developed world, alternative ecological fuels are more used recently than it was the case just few decades before. People are being encouraged to use alternative ecological fuels by authorities and various organizations concerned in environment protection through media campaigns and even through financial incentives.

At present appearance and use of substitutes does not represent serious threat for oil & gas industry. As it was mentioned before, all around the globe the demand for fuel is increasing due to overall population growth. Technology of production of alternative fuels is still in developing phase and that makes production expensive. On the other hand, production of vehicle motors and house facilities that will hopefully use new alternative fuels has not yet achieved the scale necessary for creating demand for fossil fuel substitutes. It should be rather considered as global threat for the future operations of oil & gas industry.

3. CONCLUDING REMARKS AND POSSIBLE SOLUTIONS

Based on overall known facts about oil & gas industry and research made in the field of opportunities and threats of introducing and implementation of global technology and operations strategy in oil & gas industry, several possible solution proposals and concluding remarks can be made.

As quantity of hydrocarbons reserves decreases all over the world oil & gas industry must consider possibilities of using of other unconventional sources of its primary raw materials (such as deep-water drilling or deep drilling in oilfields). Existing technologies for exploration and extraction must be improved for successful usage of the unconventional sources hydrocarbons.

Another possibility can be recognized in using unconventional fuels, such as the ones made from heavy and extra heavy oil and oil sands or shale gas. This new approach will require new technology of operations. Consequently significant investments especially in R&D sector are necessary to have this objective fulfilled.
Both international and national oil companies can broaden their global operations through IOC – NOC partnerships and cooperation. Having partnering relationships with national oil companies, the international oil companies may obtain the access to hydrocarbon reserves in the country, and national oil companies can penetrate international markets through their international partners and often obtain access to advanced technologies.

Acquisitions and strategic alliances are another type of cooperation between different oil companies that can be helpful in broadening portfolio of production, access to new advanced technologies and growing market share.

Besides opportunities, global oil & gas business faces also various threats. Political instability is one of major threats to growth of global companies. Possible government changes often followed by violence may cause losses of profit, capital and property. Another type of political threat is lack of legislative systems protecting property and intellectual property rights of foreign companies. These threats may be overcome by careful analyzing political situation in possible host countries as well as participation in founding legislative basis and its implementation in certain countries. It is especially present in emerging or underdeveloped countries.

HSE issues represent a major threat for modern oil & gas industry. Neglecting these risks may lead to various consequences from endangering company's reputation to more losses of property, human lives and high pollution and natural catastrophes. Overcoming these problems can be achieved by strict complying with HSE standards and even giving proposals to improve them and founding strong system of control and constant improvement of HSE education for working personnel. Social responsibility is desirable behavior of companies in that field.

Recent threats for oil & gas industry are new substitutes for fossil fuels. This threat should be considered as future threat as technologies of production and consumption still are not developed enough. Overcoming this threat can be achieved by developing technology of production of alternative fuels and consequently broadening portfolio of products.

Energy efficiency policies and technologies have ambivalent role with reference to oil & gas industry. They can be considered both as an opportunity and as a threat. From the point of view of consumer, oil & gas sector sees energy efficiency as an opportunity due to relatively high level of energy consumption in processes of extracting, production and refining. From the point of view of supplier, oil & gas industry may consider energy efficiency as a threat. Energy efficiency policies and advanced technology affect the demand for fuel especially in developed world. On the other hand, increasing number of people and fuel

consumers all over the world to the certain extent compensates potential losses and in a way neutralizes that threat. By this, the First Special Hypothesis is proved.

Accepting new business models, broadening portfolio of products and broadening the activities in the industry value chain may be the best strategic approach to threats response by turning them into opportunities. Some traditional oil & gas companies have already considered and even commenced with their transformations to energy holdings (British Petroleum, Gazprom, NIS…), producing both fuels and electrical power using flare gas and building wind and solar parks. By this, the Third Special Hypothesis is proved.

New approaches and ways of adopting business models, feasibility of including renewable or alternative resources into oil & gas industry should be studied and may lead to some new conclusions about profitability of such operations. Further researches in the field of management of new resource bases and coordination with traditional operations of oil & gas companies are also essential for future development of strategic planning in the field of operations and technology on global level. This proves the Second Special Hypothesis of this research.

All the mentioned activities lead to obvious transformation of oil & gas companies to large and well diversified energy holdings. These holdings are expected to respond to every energy challenge in modern societies. The fact that all the fields of activities of the holdings have common denominator – energy implies that all the business directions of the new energy holding are in perfect synergy. Thus, it proves the General Hypothesis of this research.

REFERENCES

Chemistry Views. (2012, January 3). Retrieved from Chemisty Views Web site: www.chemisryviews.org

Accenture. (2012). *Sustainable Energy for All: Opportunities of Oil & Gas Industry.* Accenture.

Bigliani, R. (2013). *Reducing Risk in Oil and Gas Operations 2013.* Framingham: IDC Energy Insight.

BP. (2013). *BP Statistical Review of World Energy.* London: BP p.l.c.

Johnson, G., Scholes, K., & Whitington, R. (2008). *Exploring Corporate Strategy.* Harlow: Pearson Education Ltd.

Luthans, F., & Doh, J. (2012). *International Management: Culture, Strategy and Behavior.* New York : McGraw-Hill.

Oil & Gas Journal. (2014, January 02). *Shell Closes on Repsol LNG Asset Acquisition*. Retrieved from Oil & Gas Journal Web site: http://www.ogj.com/articles/2014/01/shell-closes-on-repsol-lng-asset-acquisition.html

Technip. (2012, August 31). *Technip Copmpletes Acquisition of Stone & Webster Process Technologies and Associated Oil & Gas Engineering Capabilities from the Shaw Group*. Retrieved from Technip Web Site: http://www.technip.com/en/press/technip-completes-acquisition-stone-webster-process-technologies-and-associated-oil-and-gas-en

White, S. (2013). Industry Perspectives. *European Oil & Gas Issue 11*, 6-9.

DEVELOPMENT OF AN INNOVATIVE PROJECT

Zorana Mišković[1], Ivana Milinković[1]
[1]Faculty of organizational sciences
z.miskovic93@gmail.com, i.milinkovic93@gmail.com

Abstract: *Innovation can be defined as the application of new ideas to the products, processes, projects or other aspects of the activities that lead to increased "value". One of the Serbian entrepreneurs found a way how to add value to his country, how to improve society and support entrepreneurship as a formula for economic prosperity and recovery of the country through the Organization for Inspiring Entrepreneurship and projects that encourage young people to engage themselves in entrepreneurship. The project, which the Organization is currently working on, is MADE IN SERBIA. In this paper, a real-life example of a new-project development is given through the Stage-Gate model - generating ideas and the idea screen. MADE IN SERBIA is a project that aims to present Serbia abroad as a country that has a rich history, smart and noble people, but also high-quality products.*

Keywords*: Innovation project, Stage-Gate model, innovations, generating ideas, development*

1. INTRODUCTION

Innovation is a complex process. The genesis of innovation derives from a wide range of sources and its development involves various stages, often involving considerable investment. Companies are well aware that hidden in their dispersed, global operations is a treasure trove of ideas and capabilities for innovation (Rogers, Greenhalgh, 2010). While entrepreneurs and private firms are central actors in the process, there is a critical role for the government in providing a legal infrastructure and supplying basic scientific knowledge. The method of creating innovation is to discover, create, and develop ideas, to refine them into useful forms, and to use them to earn profits, increase efficiency, and reduce costs. Innovative ideas come from several sources, including unreasonable demands or goals and time pressures. However, there are many blocks to innovation. An innovative idea is not helpful to an organization unless it is tested and implemented which can be done by using the well-known Stage-Gate model.

Stage-Gate is a value-creating business process and risk model designed to quickly and profitably transform an organization's best new ideas into winning new products. When embraced by organizations, it creates a culture of product innovation excellence - product leadership, accountability, high-performance teams, customer and market focus, robust solutions, alignment, discipline, speed and quality. The Stage-Gate model takes the often complex and chaotic process of taking an idea from inception to launch, and breaks it down into smaller stages (where project activities are conducted) and gates (where business evaluations and Go/Kill decisions are made). In its entirety, Stage-Gate incorporates pre-development activities (business justification and preliminary feasibilities), development activities (technical, marketing, and operations development) and commercialization activities (market launch and post-launch learning) into one complete, robust process. Besides an ordering of activities, the approach required a go – no-go decision at the end of each phase. Since each subsequent phase will require more efforts and (financial) resources, it makes sense to reconsider the feasibility and chances on market success at fixed moments. Negative results of a business case will, for example, prevent the expensive development of a non-viable product (Iskander,2008).

2. PRE-DEVELOPMENT ACTIVITIES

2.1. Identify sources of ideas

There are millions of entrepreneurs and companies throughout the world and their testimonies suggest that there are many potential, various sources of new viable business ideas or sources of business opportunities. Some business ideas come from a careful analysis of market trends and consumer needs and others come from serendipity. Research suggests that the following are four major sources of ideas for every entrepreneur and companies (Baron, Reuber, Shane, 2007):

- Spotting Trends and anticipating their impact;
- Identifying a market niche;
- Copying ideas from other countries;
- Taking a scientific approach;

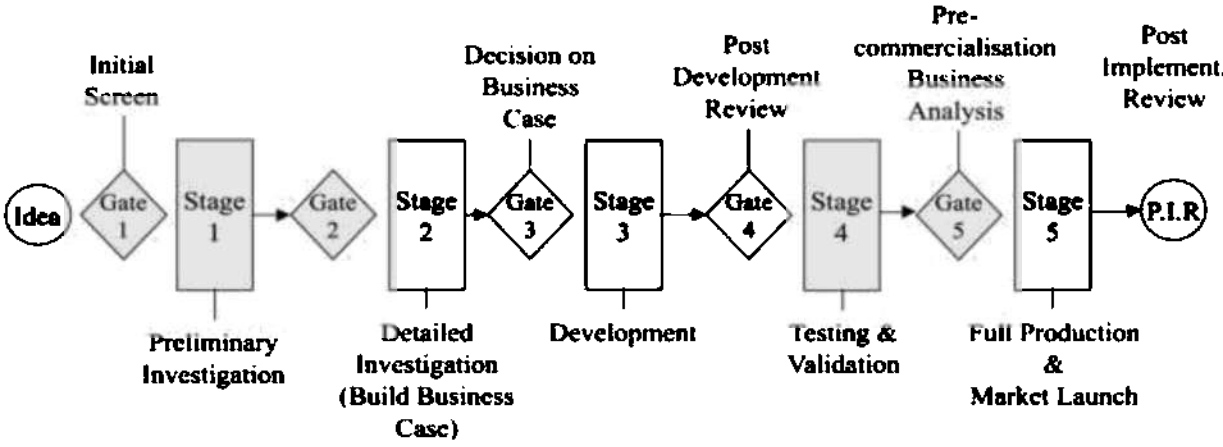


Figure 1 Stage-Gate model (according to Cooper, R. G. 2011)

Striving for constant innovation, great attention is paid to how to generate ideas. Some of the most applicable methods are:

Brainstorming - It means creating new ideas, solving problems, motivating and developing teams. Brainstorming motivates because it involves members of a team in bigger management issues, and it gets a team working together. Brainstorming places a significant burden on the facilitator to manage the process, people's involvement and sensitivities, and then to manage all required actions (Wilson, 2013).

Focus Groups - A focus group is defined as a group of individuals providing information in a structured format. A moderator leads the group of about 8 to 14 participants through an open, in-depth discussion rather than simply asking questions to solicit participants' responses. For a new product or services area, the moderator focuses the discussion of the group in either a directive or non-directive manner. The group is stimulated by comments from other group members in creatively conceptualizing and developing a new product or service to fill a market need. The focus group is an excellent approach for initially screening ideas and concepts. Existing company can use this method to expand a section or department to be able to achieve greater productivity in its services (Stewart, Shamdasani, 2014).

Problem Inventory Analysis – That is a method for obtaining new ideas and solutions by focusing on existing problems. In this approach, the customers or consumers are provided with a list of problems in a general product category. Thereafter, they are asked to identify and discuss product in each category that have a particular problem. This method is effective when an improved service/product is desired. When known product or services are related to suggested problems, a new product idea emerges. Result from product inventory analysis must be carefully evaluated as they may actually reflect a new business opportunity. For maximal result, it is advisable that problem inventory analysis should be used primarily to identify new product ideas from existing product before further evaluation (Hisrich, 2014).

2.1. The identification of gaps

Gap analysis identifies gaps between the optimized allocation and integration of the inputs (resources), and the current allocation-level. This may reveal areas that can be improved. Gap analysis involves determining, documenting, and approving the difference between business requirements and current capabilities. Gap analysis naturally flows from benchmarking and from other assessments. Once the general expectation of performance in an industry is understood, it is possible to compare that expectation with the company's current level of performance. This comparison becomes the gap analysis. Such analysis can be performed at the strategic or at the operational level of an organization (John, Acharya, Ashis, 2013).

3. GATE 1: INITIAL SCREEN

Strategic similarity
If two firms exhibit very similar resource allocation pattern as measured across a variety of strategically relevant characteristics, they can be considered to be strategically similar. Each company has a dominant logic, which represents the manner of utilization of resources, and which co-evolved with the resources within the firm. If two firms with dissimilar resource allocation patterns merge, the dominant logic of one firm will be applied to the resources of the other firm. This leads to the risk of mismatch of dominant logic and resources and thus to inferior merger success (Frensch, 2007).

Market attractiveness
The attractiveness of a target market lies not only in its size and growth possibilities but also in the promise of long-term profitability. Attractive segments attract competitors and intense competition can have a detrimental effect on future profits. Very important thing in evaluating the attractiveness of a particular target market is the selection of an appropriate set of evaluation criteria (Cant, Strydo, Jooste, Plessis, 2007).

- Market/customer factors
- Economic and technological factors
- Competitive factors
- Environmental factors

Also, determining market attractiveness is a four-step process (Sarin, 2013):

- Pre-select criteria that will be used to evaluate market attractiveness and competitive position
- Weight the market attractiveness and competitive position factors
- Rate each segment on attractiveness and competitive position
- Evaluate the implications of alternative positions within the market attractiveness/competitive position matrix for target market selection, strategic objectives, and resource allocation

After defining which products or services make money and which ones take money, evaluate which ones to invest in by looking at how attractive the market is. A widely used tool for conducting a portfolio analysis is the Market Attractiveness Framework, which provides a structure that works with your products and services. The framework looks at your portfolio based on the strengths of each product or service and its market attractiveness. The method of using the Market Attractiveness Framework is to fit your products or services in one of the three areas (Barksdale, Lund, 2006).

Technical feasibility
A business is considered technically and operationally feasible if it has the necessary expertise, infrastructure and capital to develop, install, operate and maintain the proposed system, and that by establishing such a system, the business will be able to deliver goods or services at a profit. Results from technology feasibility analysis efforts provide input to balanced portfolio development and technology validation plans. These analyses are very useful in determining which projects have the highest potential for near-, mid-, and long-term success (El – Sharkawy, 2005).

Legislative acts
With most new ideas key issue is the question of legal restrictions. Most companies in Serbia are trying to protect their originally made products. This protection will be based on the law on Geographical Indications. Geographical indications shall be the indications which identify particular goods as goods originating from the territory of the specific country, region or locality within such a territory, where a given quality, reputation or other characteristics of such goods can be essentially attributed to their geographical origin, and such goods are produced and/or processed and/or prepared within a definite geographical area.

4. REAL LIFE EXAMPLE - PROJECT: MADE IN SERBIA

The Organization for Inspiring Entrepreneurship "Živojin Mišić"
„He who dares, can. He who knows no fear, moves forward. "Živojin Mišić"

The Organization for Inspiring Entrepreneurship "Živojin Mišić" was founded in 2013 in Belgrade by a Serbian company "Devana Technologies" at the initiative of its employees. The original creator of the idea was Vladimir Prelovac, the company founder and president of the organization. The idea was born from the desire to improve society and support entrepreneurship as a formula for economic prosperity and recovery of the country. The company decided to invest a part of its profits in this idea in order to enrich the programs and projects of the organization, and to inspire young people and show them the path that will lead them to

success. As non-governmental and non-profit association, the organization invests all of the resources and decides on its own how the funds will be allocated, which of the social issues will try to resolve using its own initiative or a project, and where to focus its strategy. They are doing all that with the generous help and advice of associates and friends.
Once it was founded, established and had its ideas and goals well-structured, the organization successfully realized its first projects - "The new hopes of chess" and "Serbian Teaching Awards" in 2014. Using these projects, the organization found the essence of the problem, that is, the source of good qualities and skills people have - chess and strategic thinking, and the education of youth and their versatility. Every project of the "Živojin Mišić" Organization that came after it was driven by an idea to inspire young people in every possible way to be brave, innovative, shrewd and to create their own opportunities. In one word - to become entrepreneurs themselves. The foundation's guiding principle is to care about the progress of children in Serbia and those who have the power to bring them to the right path and turn them into great and stable people. In addition, the Association promotes entrepreneurship, it aims to support entrepreneurs who have already established their businesses, trying to help the economic development of Serbia.

Therefore, the Association is initiating the implementation of the project MADE IN SERBIA. The realization of the project starts in March, and it is planned to be completed by the beginning of September. The project is led by the Project Coordinator of the Organization for Inspiring Entrepreneurship "Živojin Mišić", and externally it engaged a team consisting of three girls. Striving towards achieving these objectives the company is constantly looking for new ideas and projects. This kind of activity opens the possibility to strengthen the entrepreneurial spirit, the economy of Serbia and enthusiasm of young people. The project "MADE IN SERBIA" is just one of many innovative actions organized by this Organization.

4.1. Made in Serbia

MADE IN SERBIA is a project that aims to present Serbia abroad as a country that has a rich history, smart and noble people, but also high-quality products. In the world there are products that are of superior quality which originate from Serbia, but no one is aware of this fact. One of these products is the Manage WP, created by Devana Technologies, which is one of the world's premium products, and has customers like NASA, Stanford University, but no one knows that the idea of the product is developed in Serbia, where the product is still maintained and developed. The idea of the project Made in Serbia came precisely on the basis of the case of this product, and through further research it was concluded that there were a lot more products like Manage WP in Serbia.

The basic idea is to create an online platform which will be a perfect place for presenting the best products from Serbia. The products will be given the badge "MADE IN SERBIA", and their promotion will take place on the portal. The portal should present our country, our famous people, as well as the products themselves and companies that made them.

Development activities of the project are:
- Activity 1. Define the project goals and establish cooperation with eminent national institutions
- Activity 2. Selection of companies
- Activity 3. Creating a site
- Activity 4. Promotion of the site and the companies

Activity 1

The aim of this project is to encourage the entrepreneurial spirit in Serbia through examples of successful local companies and their paths to success and also to explain to entrepreneurs that everything is possible.
The long-term goal is to change the image of Serbia and Serbian products in the world through examples of successful companies and successful people. Presentation of quality Serbian products to the world leads to the development of Serbian economy. Intention is to create a new brand MADE IN SERBIA that will become synonym for products with the best quality. Such lofty goals require the assistance of the eminent institutions of, such as the Ministry of Economy and the Serbian Chamber of Commerce. One representative in front of the each institution is a part of a committee that will choose which companies should be on the portal trying to present Serbia in the best possible way.

Activity 2

The website MADE IN SERBIA needs to present only products of superior quality. Therefore, selection should be done in the best way. The selection is defined by a set of criteria. The defined criteria serve as the

backbone of the determinants of quality. The criteria that should be taken into account through the selection process of companies are:

- MADE IN SERBIA - idea for the development of the product is developed in Serbia, the product produces, develops, maintains in Serbia
- Product quality
- Acknowledgement that the product has won
- The presence on the international and / or domestic market
- Innovation
- Social liability
- Tradition of the product

A professional jury from the database of companies will choose those that meet criteria - a product of high quality. The goal of the Association is to take out the best of each area and select representatives who will represent Serbia in the portal. This jury will include representatives of the Serbian Chamber of Commerce, the Ministry of Economy, EY company, as well as experts in the field from which products would be chosen. The company will not pay any compensation for the promotion on the portal and all costs of this project is fully covered by the Association. After the jury agree on about which companies deserves to be on the portal, it will be organized the ceremony at which companies will receive recognition and hear the importance of having a badge MADE IN SERBIA on their website. This project was not conceived as a competition in which companies must apply and then the jury chooses the best. The selection should be internal, and only companies that should appear on the portal will be invited and informed about the choice. Competitions of this type already exist and MADE IN SERBIA does not want to be one of them.

Activity 3

The most important thing in this activity of creating site is to use the opportunity and show what Serbia actually is, and what Serbia has to offer. This site should be divided into three sections:

- **Our business** is the part where will be presented products and companies. The goal is to get from each company a story that is characteristic for them. For example: How did they get the idea to develop the product? What makes this so special? In which countries is the company selling their product? These stories should motivate others to do something similar, which will in many ways affect the development of our country and economy.
- **Our country** - Serbia is a country of real natural beauty, irresistible taste, tradition and unforgettable entertainment. In this section, Serbian culture should be presented, beautiful parts of the country, food that is always interesting to foreigners and also the festivals that bring together the whole world in one place.
- **Our people** - Why people around the world do not know that Tesla, Pupin, Andrić, Đoković and many other successful people are Serbs? In this part of the site we would like to put the stories of great people from our past and their achievements.

Activity 4

At the end it remains to do a good promotion of portal in Serbia, but also around the world. Through the websites of companies which will have the MADE IN SERBIA badge, the story of our country and economy will become available to everyone. Promotion activities will be focused on digital media.

Digital media, which includes Internet, social networking and social media sites, is a modern way for brands to interact with consumers as it releases news, information and advertising from the technological limits of print and broadcast infrastructures. Digital media is currently the most effective way for brands to reach their consumers on a daily basis. Over 2.7 billion people are online globally, which is about 40% of the world's population. 67% of all Internet users globally use social media (Mulhern, 2009).

5. THE PROJECT „MADE IN SERBIA“ THROUGH FIRST GATE OF “STAGE-GATE” MODEL

Strategic similarity

Strategic similarity can be seen as a new concept of development of the project, which must be in accordance with the Strategy, the company itself.

As we can see, the main goal of the project „Made in Serbia“ is to demonstrate how much Serbian people have achieved. The story is not only about products, it is about people and quality which can make our entrepreneurs and our country proud. Through this first gate of „Stage-Gate“ model, the study was about how competitive and organizational similarity jointly affect cost savings, revenue growth and profitability improvement.

If we now make a comparison with main objectives of foundation „Živojin Mišić“ – „To encourage citizens and society in general to take initiative and believe in above-average results“, we can see that project „Made in Serbia“ fits easily in the field of the strategic focus of the foundation mentioned above and „Devana Technologies“, as the company founder. The line that connects them all is belief that starting your own business, self-employment and employment of others are a certain way to ensure economic progress and recovery of the country.

Market attractiveness
As the project clearly emphasizes the importance of domestic products and Serbian culture, a very important factor is attractiveness of Serbian market, economy and environment.

In 2015, the Serbian economy has emerged from recession into which it has entered in 2009. There has been growth in GDP of 0.8 percent. Fiscal adjustment and structural reforms have resulted in the improvement of the business environment in Serbia, and the realization of major investments, especially private ones. In 2016, faster growth in economic activity to 1.8 percent is expected based on exports and investment. The sectors that showed the highest dynamics are: manufacture of tobacco products, other manufacturing activities, manufacture of textiles, manufacture of machinery and equipment, as well as the production of basic pharmaceutical products and preparations. Currently, Serbia is characterized by improving foreign position - exports of goods and services recorded a faster growth compared to the growth of imports. The coverage of imports by exports was 74 percent, which represents an improvement compared to the previous year. National Bank of Serbia predicts that reducing external imbalances and strengthening the external position will continue in the coming years. The sectors that had the most significant share in exports were road vehicles, electrical machinery and equipment, fruit and vegetables, cereals and cereal products, and non-ferrous metals. As the most important export destinations stand out Italy, Germany, Bosnia and Herzegovina, Romania, the Russian Federation and the countries of the region (Serbian Chamber of Commerce).

Relying on that fact, domestic companies and entrepreneurs need to be aware of enormous potential that their country has. In addition to their awareness they also need to raise the trust in every citizen of Serbia and people beyond their borders. That is the main objective of the project „Made in Serbia“ – Trying to make a difference in the world and doing that every day.

Serbia is full of people with great entrepreneurial potential and because of that the number of employees in 2015 has increased. Spurred exit from recession, after two full years, legal entities were formally employed 1.35 million people, which is 31,000 more than last year (2.4 per cent). A positive trend was also recorded in the service sectors, which signals the "awakening" of entrepreneurship, and reducing the informal economy (Serbian Chamber of Commerce).

The most important is to inspire, encourage and teach young people how to engage in developing their own products and to raise awareness about its importance. Numerous examples have shown that Serbian market is very suitable for the development of products/services. One such example is the confidence of the French Government. In 2015, our Chamber has received about 130 pie foreign companies from France interested in local market (CCI France Serbie, 2015).

Technical feasibility
Trying to highlight the importance of local producers, project “Made in Serbia” is also focusing on finding the best way to ensure all potential investors that Serbia has a very fertile natural environment for all kinds of product and services. Some of the main poles of the development are:

- Transport
- Energy
- Real estate and construction
- Labor and human capital
- Telecommunications and information technology

Legislative acts
Company Devana Technologies, Foundation “Živojin Mišić” and consequently the project “Made in Serbia” are trying to protect the products which are made in Serbia. Because of that, the main problem will be to ensure foreign people that all the mentioned products are completely made in Serbia. This can be done using the law based on Geographical Indications.

6. CONCLUSION

With the great pleasure and pride based on objective parameters it can be concluded that most celebrated Serbian products can stand on the same level with the more affirmed international brands. However, their implementation on the world market request adequate representation of products in foreign countries, which as the most important characteristic recognize quality. Knowing the market development needs and potential of the regional and individual sectors and established investment strategy and the strategy of industrial development, are essential in order to identify desirable investors who want clear insight into the situation and potential of each sector to invest in what they are interested. That can help the development of Serbian economy in so many ways.

The best results of our technical and technological efforts must find their way to the prestigious "Planetary market". A significant step is the quality, strenuous marketing and ongoing commitment to raising the reputation of our country in all aspects, both in Europe and around the world.

REFERENCES

Barksdale, S.,& Lund, T. (2006). *10 Steps to Successful Strategic Planning.* American Society for Training and Development.

Baron, R., & Shane, S. (2007). *Entrepreneurship: A process perspective.* Nelson Education.

Blokdijk, G. (2015). *Vision statement – Simple steps to win, Insights and Opportunities for Maxing Out Success.*Complete publishing.

Boby, J., &Acharya, A. (2013). *Quality and Reliability Engineering: Recent Trends and Future Directions.* Allied Publishers.

Cant, M.C., Strydo, J.W.,Jooste, C.J.,& Plessis P.J. (2007). *Marketing Management.* Juta Academic, Fifth Edition.

CCI France Serbie. Retrived from: http://www.ccfs.rs/

Cooper, R. G. (2011). *Winning at new products: Creating value through innovation.* Basic Books.

Chamber of Commerce and Industry of Serbia. Retrieved from: http://www.pks.rs (Privredna komora Srbije)

Devana Technologies. Retrieved from http://devana.rs/

El – Sharkawy, A. (2005). *Economic Feasibility Studies.* Faculty of Engineering, Cairo University.

Farmer, A. (2007).*Handbook of Environmental Protection and Enforcement.*Earthscan.

Frensch, F. (2006). *The Social Side of Mergers and Acquisition.* Disertation Technische Universitat Berlin.

Hisrich, D., R. (2014). *Advanced Introduction to Entrepreneurship.*Edward Elgar Publishing.

Hudson, S., Huang, L., Roth, M. S., & Madden, T. J. (2015). The influence of social media interactions on consumer–brand relationships: A three-country study of brand perceptions and marketing behaviors. *International Journal of Research in Marketing.*

Hudson, S., Roth, M. S., Madden, T. J., & Hudson, R. (2015). The effects of social media on emotions, brand relationship quality, and word of mouth: An empirical study of music festival attendees. *Tourism Management, 47, 68-76.*

Iskander, M. (Ed.). (2008). *Innovative techniques in instruction technology, e-learning, e-assessment and education.* Springer Science & Business Media.

Wallace, L. K. (2004). *Libraries, mission & marketing: Writing mission statements that work.* American Library Association.

Mulhern, F. (2009). Integrated marketing communications: From media channels to digital connectivity. *Journal of marketing communications*, *15*(2-3), 85-101.

Mulhern, F. (2009). Integrated marketing communications: From media channels to digital connectivity. *Journal of marketing communications, 15(2-3).*

Organization for Inspiring Entrepreneurship.Retrieved from: zivojinmisic.rs

Greenhalgh, C., & Rogers, M. (2010). *Innovation, intellectual property, and economic growth.* Princeton University Press.

Rouillard, L. (2003). *Goals and Goal Setting: Achieveing Measured Objectives.* Cengage Learning.

Sarin, S. (2013). *Business marketing: Concepts and cases.* Tata McGraw-Hill Education.

Stewart, D. W., & Shamdasani, P. N. (2014). *Focus groups: Theory and practice* (Vol. 20). Sage Publications

Stošić, B. (2013).*Management of innovation, innovation projects of models and methods.*Faculty of Organizational Sciences, Belgrade.

Talbot, M. (2003). *Make Your Mission Statement Work: Identify Your Organisation's Values and Live Them Every Day.* How To Books Ltd.

Wilson, C. (2013). *Brainstorming and beyond: a user-centered design method.* Newnes.

INDEX

A

Aćimović Vera 146
Andrić Gusavac Bisera 565
Anđelković Jelena 1160
Anđelković Labrović Jelena 689, 1457
Aničić Nenad 805
Aničić Rastko 626
Antić Slobodan 962
Antović Ilija 1253
Arsić Milos 476
Arsić Sinisa 476
Ašković Bojana 1096
Atanasković Predrag 458
Aydın M. Şirin 1020

B

Babarogić Slađan 805
Babić Danića 1396
Backović Nemanja 816
Bačević Miloš 324
Badovinac Nenad 318
Barać Dušan 265, 432
Barjaktarović Rakoćević Sladjana 658
Begićević Redzep Nina 241
Belić Ana 48
Benković Slađana 665
Bjelaković Ana 68
Bjelica Dragan 1081, 1088, 1331
Bjelobaba Goran 415
Blagojević Srđan 1319, 1339
Blazevska-Tabakovska Natasa 1102
Blažić Tijana 2
Bobar Zoran 125
Bogdanoska Jovanovska Mimoza 1102
Bogdanović Zorica 345, 424
Bogićević Sretenović Marija 778
Bogojević Arsić Vesna 635
Bojanić Dragan 1319, 1354
Bojović Živko 402, 408
Borisavljević Miloš 1154
Borojević Tatjana 559
Bošković Aleksandra 1382
Bubnjević Dalibor 806
Bulajić Milica 83, 91

C

Cice Jelena 1144
Cicvarić Kostić Slavica 111, 146, 1296
Cvetić Biljana 1056
Cvetkoska Violeta 241
Cvijović Jelena 889, 893
Čobrenović Ana 1183
Čudanov Mladen 838, 1108, 1305
Ćirović Marko 531, 572

D

Dabetić Djordje 701
Dacić-Pilčević Aleksandra 452
Damnjanovic Vesna 1235
Danilović Miloš 954
Delias Pavlos 187
Delibašić Boris 221
Demirović Ranko 1465
Despotović-Zrakić Marijana 285, 329
Dias Lopes Jose 617
Djurica Maja 678
Dmitrovic Veljko 673
Dobrota Marina 68, 83
Dožić Slavica 854
Dragojlović Aleksandar 604
Dragović Ivana 650
Drakulić Mirjana 1125
Dumnić Slaviša 458
Dundović Čedomir 546
Dupljanin Đorđije 458

Đ

Đoković Aleksandar 228
Đordan Andrijana 1160
Đorđević Aleksa 48
Đorđević Katarina 318
Đorđević Lena 962, 970
Đorđević Valentina 265
Đorđević Vedrana 995
Đurđević Natasa 372
Đurić Igor 345, 424
Đurić Javorka 650
Đurić Mladen 1225, 1242, 1154
Đurić-Atanasievski Ksenija 125

E

Erić Ivana 1389

F

Filipović Jovan 1220

G

Gajić Vedrana 755
Gigović Ljubomir 10
Glogovac Maja 1205
Gregec Nikola 947
Grgurović Biljana 338
Güney Baha 1020

H

Hadziahmetović Maja 54
Horvat Ana 1198

I

Ilić Bojan 816
Ilić Milića 1225
Ilić Oliver 954
Ilić Tanja 1359
Istrat Višnja 184
Ivanćević Sonja 733
Ivković Aleksandar 396

J

Jakić Gordana 1160
Jakovljević Tamara 1183
Jančić Željka 1045
Janičić Radmila 882
Janković Ana 201
Jaško Ondrej 159, 1108
Jednak Sandra 824
Jelić Gordana 312
Jeraj Mitja 495
Jeremić Veljko 100
Jeremić Zoran 76
Jevtić Milica 1465
Jevtić Miloš 169
Jezdović Ivan 396
Jovanović Bojan 778, 898
Jovanović Luka 1225
Jovanović Marko 678
Jovanović Milenković Marina 279, 446, 799
Jovanović Milica 1374, 1436
Jovanović Olga 1442
Jovanović Pavle 34
Jovanović Predrag 1133
Jovanović Svetlana 1125
Jovanović Vladimir 611
Jović Marija 920
Jugović Tijana 133

K

Kalić Milica 1405
Kandić Sanja 1213
Kankaraš Milan 1312
Katić Ana 565
Kijanović Nemanja 847
Kirchner Kathrin 187
Knežević Đorđe 408
Knežević Snežana 611, 673
Kočijašević Strahinja 1144
Kokotović Dunja 504
Kokotović Tijana 504
Komazec Stefan 159, 169
Koncar Jelena 1422
Kostić-Stanković Milica 139, 893, 889
Kovačević Ivana 694, 713
Kovačić Mirjana 546
Kragulj Dragana 824
Kranjac Mirjana 792
Krivokapić Jovan 1305
Krneta Sofija 771
Krnić Radovan 854
Kujačić Momčilo 898
Kuljanin Jovana 1405
Kutlača Đuro 865
Kuzmanović Marija 2, 100, 913

L

Labus Aleksandra 329, 387
Lalić Bojan 298
Lalić Danijela 119
Lazarević Saša 1263, 1272

Lečić-Cvetković Danica 970, 1003
Leković Sonja 1422
Levi Jakšić Maja 1374, 1436
Lisec Andrej 552
Lojić Ranko 1312
Lošić Pavle 408
Lukić Bojana 1205
Lukić Marija 745
Lukovac Vesko 10

LJ

Ljepava Nikolina 882
Ljiljanić Nikola 873

M

Makajić-Nikolić Dragana 48, 577, 658
Malbašić Una 256
Malinović Sonja 111
Mamula Tartalja Danica 312
Marčetić Nenad 1027
Marcikić Aleksandra 598
Marič Miha 495, 678
Marić Nataša 1296
Maričić Milica 83
Marinković Sanja 1045, 1465
Marinović Minja 54
Marjanović Ugljesa 298
Marković Aleksandar 61, 354
Marković Dragana 213
Marković Petar 187, 221
Marković Sanja 1198
Marković Sara 1242
Marković Stefan 978
Martać Rastko 297, 432
Matejić Sanja 396
Matović Dajana 184
Mesic Teodora 644
Mihailović Dobrivoje 713
Mihailović Jovana 18
Mihić Branimirka 1190
Mihić Marko 476, 1066
Mijatović Ivana 1235
Miladinović Slobodan 873
Milanović Dragan 986
Milanović Nemanja 665
Milčić Marija 1116
Milekić Matija 572
Milenković Dejan 446, 799
Milenković Ivan 762, 788
Milenković Nemanja 228, 1056
Milenkovic S. Dejan 279
Milić Miloš 1272
Milićević Vesna 816
Milinković Ivana 713, 1483
Milinović Suzana 285
Milosavljević Gordana 689
Milosavljević Miloš 665
Milosev Dejana 133, 926
Milosević Nela 658
Milosević Pavle 234
Milovanović Ana 626
Milovanović Jovan 644
Milovanović Marina 522
Milutinović Radul 1428
Minić Nemanja 745
Mirković Predrag 484
Misita Mirjana 986
Mišković Zorana 1483
Mitić Nemanja 201
Mitrović Maja 26
Mitrović Zorica 1074, 1081, 1331
Momčilović Marina 1176
Mrvić Jovana 1449

N

Nedeljković Miloš 1154
Nenadović Ana 180
Nestorov Aleksandar 986
Nešković Siniša 1281
Nikolić Nebojsa 708, 1325
Nikolić Neda 701
Novarlić Miljana 297, 432
Novčić Branka 920

O

Obradović Vladimir 1066, 1296
Okanović Milan 1457
Omerbegović-Bijelović Jasmina 484, 995, 1003
Orlić Nenad 270
Ožegović Spasenija 1346

P

Pajić Ana 755
Palibrk Milko 184
Pamučar Dragan 10
Panić Biljana 694
Pantelić Ognjen 755
Parežanin Miloš 824
Paunović Vladan 701
Pavićević Milica 1359
Pavlović Dejan 1396
Pejić Vaska 552
Pejović Gordana 1220
Peljko Žiga 495
Pepić Marko 585
Perišić Jasmina 345, 522
Petković Jasna 590, 778
Petrović Bratislav 34, 234
Petrović Dejan 1066
Petrović Katai Zita 1422
Petrović Mila 933
Petrović Nataša 538, 559, 572
Poledica Ana 213
Popovčić-Avrić Snežana 832
Popović Milena 565
Pribićević Ivan 1144
Prtenjak Milan 940

R

Radaković Jelena Andreja 585, 590
Radenković Božidar 387, 424
Radisavljević Tijana 354
Radonić Milenko 995
Radosavljević Vitomir 312, 338
Radovanov Boris 598
Radovanović Ljiljana 380
Radovanović Nikola 673
Radović Milić 1011
Rakićević Aleksandar 34, 626, 644
Rakić Bogdan 504, 1449
Rakićević Jovana 91, 1374, 1436
Rakićević Zoran 484, 947, 1003
Ranković Biljana 1183
Ratković Tatjana 733
Ratković Aleksandra 1449
Ristić Slobodan 799
Ristić Vladimir 1319, 1339
Rodić Dusanka 725
Rodić Trmćić Branka 387
Ruso Jelena 1198, 1220

S

Savić Ana 415
Savić Dušan 1253
Savić Gordana 91, 577, 604
Savić Milica 745, 1305
Săvoiu Gheorghe 838, 1108, 1442
Sekulović Ivan 1474
Semenčenko Dušica 865
Senegačnik Marjan 538, 559
Sikimić Uroš 792
Simeunović Barbara 1011
Simić Dejan 762, 788
Simonović Dragoljub 279
Skoog Matti 1291
Slović Dragoslav 1011, 1036
Srećković Stefan 207
Staletić Nada 304
Stanišić Igor 1263
Stanković Ranka 439
Stanojević Bogdana 41
Stanojević Dražena 720
Stanojević Kristina 577
Stanojević Milan 41
Stanojević Terzić Slobodanka 152
Stanojević Vojislav 1272
Starčević Dušan 771
Stefanović Ivan 737, 1027, 1176
Stefanović Tijana 1457
Stevanović Dejana 585
Stojadinović Tatjana 380
Stojanović - Aleksić Vesna 1382
Stojanović Dragana 1036
Stojanović Katarina 1242
Stojić Nenad 452
Stojimirović Dejan 1281
Stojković Dejan 1312
Stosić Biljana 1428
Stupar Mihailo 234
Suknović Milija 207, 221
Surla Katarina 256

Šarac Dragana 898, 1346
Šestović Marina 832
Šormaz Jelena 100
Šošević Uroš 771
Štavljanin Velimir 889
Štrbac Dijana 1415
Štrbac Slavica 338

T

Taicu Marian 838
Tasić Nemanja 298
Teke Çağatay 1020
Todić Tamara 832
Todorović Ivan 159, 169
Todorović Marija 1074, 1081, 1088
Toljaga-Nikolić Danijela 1074, 1088, 1331
Tomašević Ivan 1036
Tomić Srđan 792
Tornjanski Vesna 1045
Trajković Ana 1190
Turajlić Nina 1281

U

Unterberger Marija 1346

V

Vanevski Igor 380
Vasić Danko 947
Vasilić Slobodan 926
Vasiljević Dragana 285
Vasković Jelena 324
Vasković Vojkan 270
Veselinović Tamara 119
Vesić Slavimir 805
Vesović Vladimir 1291
Vidojević Branislav 1116
Vignjević Milan 531
Vlahu-Gjorgievska Elena 1102
Vlajić Siniša 1253
Vlastelica Tamara 111, 119, 146
Vranić Nevena 650
Vrbanac Maja 522
Vucenovic Tamara 1125
Vučinić Jelena 933
Vujin Jovana 365
Vujošević Mirko 694, 978
Vujović Stefan 265
Vuk Drago 538
Vukić Ksenija 913
Vukić Milena 913
Vukićević Milan 201, 207
Vukmirović Aleksandra 228, 446
Vukmirović Dragan 1133
Vukmirović Jovanka 1133
Vukmirović Nikola 513
Vukmirović Valentina 133, 139, 513
Vuletić Predrag 402
Vulović Nikola 439

Z

Zahirović Suhonjić Anida 329
Zdravković Dušan 464
Zdravković Stefan 439
Zekić Astrid 546
Zivadinović Milos 788
Zivković Nedeljka 1167
Zornić Nikola 61
Živančević Sanja 213
Živić Miloš 970
Živković Ksenija 762
Živković Lazar 865
Živković Nedeljko 1205
Žnidarič Davorin 1368

ISBN 9788676803262